THE INTELLECTUAL OBSERVER.

DECEMBER, 1862.

ON A FEATHERED FOSSIL FROM THE LITHOGRAPHIC LIMESTONE OF SOLENHOFEN.

(*Lately acquired for the British Museum.*)

BY HENRY WOODWARD, F.Z.S.

(*With a Coloured Plate.*)

It has always been held that the form and proportions of any symmetrical object may be inferred from the inspection of a part or fragment of the whole. The disciples and admirers of Cuvier have often asserted that it was possible for those who (like that great anatomist) possessed the requisite knowledge, to reconstruct the entire frame of any extinct animal from a single bone, or tooth, or claw. These notions went, doubtless, far beyond the pretensions of the illustrious founder of the science of comparative osteology, and they have led to mistakes and disappointment; but they serve to show the strength of the conviction which long ago found expression in the proverb, "*ex pede Herculem.*"

That the existence of birds at the period of the Secondary rocks should have been first intimated by their *footprints*, may seem strange; but as far back as 1835 a notice appeared in Silliman's *American Journal of Science*, stating that Dr. Deane had discovered impressions *resembling the feet of birds* upon some slabs of red sandstone from Connecticut. Dr. Hitchcock was the first who submitted these tracks to careful scientific examination, and concluded that they had been produced "*by the feet of birds* which must have been at least *four times larger* than the ostrich." These gigantic three-toed footprints have been found in more than twenty places, scattered through a tract nearly eighty miles long, and they are repeated through strata more than one thousand feet thick.* Upwards of two thousand of the *Ornithichnites* had been observed and examined by Professor Hitchcock twenty years ago; but notwithstanding the most diligent and careful search, not a vestige of the organic remains of either bird or pterodactyle have as yet been discovered in these beds. Numerous coprolites occur in

* Lyell's *Manual of Geology*, fifth edition, p. 348.

the Connecticut rocks, and Dr. Dana has very ingeniously argued from an analysis of these bodies, that, like guano, they are the droppings of birds rather than of reptiles.

In the strata between these red sandstones (formerly considered to be of Triassic age and now attributed by modern American geologists to the Lias or Oolite) and the lower Eocene, only two discoveries of reputed bones of birds have been made. The first of these is the *Cimoliornis diomedeus*, a long-winged bird from the chalk of Burham, near Maidstone, described in 1840 by Professor Owen in the *Geological Transactions*, second series, vol. vi., from a leg and wing-bone which he considered to have belonged to "one of the longipennate natatorial birds, equalling in size the albatross."*

In May, 1845, Dr. Bowerbank figured and described (in *Quarterly Journal of the Geological Society*, p. 7, pl. 1) several bones and a part of the head of a pterodactyle, from the same chalk pit at Burham, near Maidstone, and after carefully comparing these with the shaft of the humerus of *Cimoliornis*, he was led to believe that it also was the bone of a pterodactyle and *not a bird*. In Dixon's *Geology of Sussex*, edited by Professor Owen, in 1850, this wing-bone is again figured and described as that of a bird. The arguments in favour of the Professor's theory are there given at length, to which I must refer the reader, pp. 402-3.

In a subsequent work,† the *Cimoliornis* is omitted, and the *Pterodactylus giganteus*, Bowerbank, from the middle chalk of Kent, is recognized as one of the largest and the last of the flying reptiles known.

The second recorded discovery of bird remains in the Mesozoic rocks is noticed in the supplement to Sir Charles Lyell's fifth edition of his *Manual of Geology*, 1859, p. 40: "Mr. Lucas Barrett in 1858 discovered the remains of a bird in the Upper Greensand, near Cambridge, a formation worked extensively for phosphate of lime, extracted from coprolitic nodules. The bird was rather larger than the common pigeon, and probably belonged to the order natatores, and, like most of the gull tribe, had well-developed wings. Portions of the metacarpus, metatarsus, tibia, and femur have been detected, and the determinations of Mr. Barrett have been confirmed by Professor Owen." These bird bones remain unchallenged, but are the only true ones on record.

Ornitholites have been met with in at least a dozen different localities in the tertiary deposits of Europe, and also at two or three places in our own island.

We possess, in the geological collection of the National

* Owen's *British Fossil Mammals and Birds*, 1846, p. 547.
† Owen's *Palæontology*, second edition, 1861, p. 275.

Museum, specimens from the Miocene of Allier, in France, and Œningen, near Constance; from the Upper Eocene of Puy de Dôme, Perignat, and Auvergne; and from the Eocene of Montmartre and Meudon, near Paris; and from our own Eocene of Hordwell and Sheppey. We have also the remains of a large bird from the Sewalik Hills of India; casts of the bones and egg of the Æpyornis from Madagascar, and the entire skeleton of the Dinornis, and very numerous separate bones of this genus and Palapteryx from New Zealand. With the two exceptions of the Eocene slate rocks of Glaris, in which the almost entire skeleton of a small passerine bird, about the size of a lark, has been discovered, and the gypsum quarries of Montmartre, where two or three connected skeletons of different species of birds have been found, these remains consist of *detached bones or fragments only*, or of eggs (from Auvergne) or feather impressions (from Aix and Bonn). Indeed, the whole collection of *Ornitholites* known could be displayed in a single table case of ordinary size.

This, of course, is *exclusive* of the great New Zealand and Madagascar wingless birds, the Dinornis and Æpyornis, the Notornis and Palapteryx, which, like the Dodo and Solitaire, have perhaps all been exterminated by the agency of man, or within the historic period. When we compare this dearth of evidence in the geological record with the vast numbers of species of living birds (very partially illustrated by the collection of stuffed examples in the Ornithological Gallery of the British Museum), we cannot but ask the question—Why are no fossil birds found in strata in which remains of other animals frequently occur, which *at first sight* appear as little likely to have been preserved as the bones and feathers of a bird? Sir Charles Lyell remarks, that "the powers of flight possessed by most birds would insure them against perishing by numerous casualties, to which quadrupeds are exposed during floods." And again, "If they chanced to be drowned, or to die when swimming on the water, it would scarcely ever happen that they would be submerged, so as to become preserved in sedimentary deposits."

That they can be readily preserved under favourable circumstances is proved by the fine examples found at Montmartre and Glaris.

That we shall have to record many more ornitholitic discoveries is, I think, proved by the startling announcement which appeared in print, for the first time in England, in the *Annals and Magazine of Natural History* for April last, headed "On a new Fossil Reptile, supposed to be furnished with Feathers," by A. Wagner.* In May appeared another paper,

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"On the *Archæopteryx lithographica*, from the Lithographic Slate of Solenhofen," by Hermann Von Meyer.*

In referring to the notices given of this wonderful discovery, I prefer to take H. Von Meyer's paper *first*, as being the palæontologist who *first* really called attention to the subject. He reminds us, that "feathers, or indeed any remains of birds, have hitherto been known in no rocks older than the Tertiary period;" and that in the lithographic slate, osseous remains of birds have frequently been supposed to occur, which upon closer investigation appeared to belong to *Pterodactyles* (perhaps to *Rhamphorhynchi*), from the structure of which we cannot infer that the animals were clothed with feathers, and no traces of feathers were ever seen with the numerous Pterodactyles found, the skeletons of some of which were perfect. He goes on to say, "This rendered it the more surprising, that recently a feather should be brought to light, precisely in the same formation, and even at the same spot, which furnishes the greatest number of Pterodactyles. The object," he adds, "occurring on the stone, agrees in all its parts so perfectly with the feather of a bird, that it is impossible to distinguish it therefrom." After a most minute description he concludes, "The fossil feather of Solenhofen, therefore, even if agreeing perfectly with those of our birds, need not necessarily be derived from a bird. And indeed a feathered animal, differing essentially from our birds, has occurred in the lithographic slate. My informant is M. Witte, of Hanover. This gentleman saw, in the possession of M. Häberlein, of Pappenheim, upon a slab of Solenhofen slate, an animal, of which he remarked that it possessed feathers, and that the feathers of the tail were attached, not as in birds, to the last vertebra, but on each side of the caudal vertebræ. They were, moreover, quite distinctly furnished with stem and vane. The simple tarsus of itself shows that this animal does not belong to the Pterodactyles, and the formation of the tail contradicts the idea that we connect with our birds, yet the feathers are not distinguishable from those of birds. The fossil feather described by me will be derived from a similar animal."

Dr. Wagner's paper (written shortly before his death) was wholly founded on report. Having, like Von Meyer, received from M. Witte, of Hanover, a description of the fossil in M. Häberlein's collection, and also read a notice of Von Meyer's feather from the same formation, he subsequently procured

* Translated from the *Palæontographica*, vol. x. p. 53, by the same author foregoing.

A short notice of these two papers will be found in the INTELLECTUAL OBSERVER, No. 5, for June last, page 367.

from a friend* a fuller description of the fossil, which he quotes at length.

From this report he was led to conclude that the affinities of this wonderful creature were strongest to the Saurian reptiles, and accordingly he regarded its natural covering as merely "presenting a deceptive resemblance to feathers," and he named it *Griphosaurus* (from γρῖφος, an enigma).

Fortunately for English palæontologists, through the exertions of Professor Owen and Mr. G. R. Waterhouse (the latter of whom made it the object of a special journey to Pappenheim), this unique fossil has been acquired for the geological collection in the British Museum. Here it will be open to the observation of all the world, and (before the issue of this present number) will be described by Professor Owen before the Royal Society, under the name of *Griphornis longicaudatus*, who thus indicates his conviction that it is a *bird*.†

The lithographic limestone of Solenhofen, near Munich, presents a strong resemblance in lithological character to the White Lias, but its fossils are probably of the age of the Kimmeridge clay. The formation is of marine origin, and abounds in remains of cuttle-fishes, resembling in condition and character the fossils of our lower Oxford clay at Chippenham, ammonites, nautili, crustacea, fishes, and also of winged insects and pterodactyles. From the immense demand for this stone for lithography, the quarries are as extensive as any in Europe. The quarrymen work upon the lines of stratification, which are beautifully parallel, and all the fossils are found upon the natural surfaces, presenting an impression and counterpart in almost every instance. The stone is often quarried to the depth of eighty or ninety feet! This feathered enigma presents precisely similar appearances to all the other included organic remains, being imbedded upon the surface of one layer, and impressed in intaglio into the one overlying it, which bears not only the cast, but portions of the bones upon its surface.

The feathers, which are most beautifully preserved upon the lower slab, were indistinct *at first*, being originally covered by a thin film of fine calcareous mud, which M. Häberlein removed, so as to exhibit the tail and wings, and some further portions of the skeleton itself. The head, neck, and dorsal vertebræ are wholly wanting. The right scapula and humerus and both the fore-arms are well preserved: the former bones are present on the left side, but imperfect; the fore-arm consists of radius and ulna; a metacarpal bone is present on the left side, lying

* The friend appears to have been his present successor in the museum of Munich, Dr. Oppel.

† The figure presented herewith is sketched from the actual specimen, and carefully reduced. Professor Owen decided at the last moment to retain the name *Archæopteryx*.

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beside the radius and ulna; there are also some small detached bones, which no doubt are finger bones. Above the wing feathers on the left hand may be noticed two small slender bones, to which sharp claws, similar to those of the foot, are articulated. These may have been used for clinging, like those of the pterodactyles and bats, or as offensive weapons, like the fighting spur with which the wings of the spur-winged goose of the Cape and Central Africa, the Chaja Screamer (related to the Rails) from Cayenne, and some others are armed.

The "merrythought," or *furculum*, is seen lying between the wings. The ribs, small and unbird-like, are detached, and scattered on the surface, as if the head, neck, breast, and body had been torn off or eaten out by some other bird of prey or small carnivorous animal, wandering at low water upon the estuarine flats bordering that ancient oolitic sea.

The lower right limb is well preserved, and consists of femur, tibia, and tarso-metatarsal bones; to the latter bone four toes are articulated, one hind toe and three fore toes, having severally 1, 2, 3, and (4 ?*) joints, *as in all birds*, and armed with strong hooked claws. The thigh and shank *only* of the right limb remain. The pelvis is well preserved on the left side, showing the cup-shaped cavity in which the head of the femur moved.†

The *sacrum* (so conspicuous in all known birds) cannot be traced in this skeleton, unless the stained surface of the stone indicates its remains. That one existed by which *a few* at least of the sacral vertebræ were firmly fixed together may be fairly concluded, for the hind limbs seem well adapted for hopping, running, or perching; and the wings (which evidently were adapted for flight) must also have received support in proportion to their size from the body of the animal.

The whole of the vertebræ of the tail are completely and beautifully preserved. They are twenty in number, of a narrow, elongated form, the dimensions of which slowly but constantly diminish, so that the last is the smallest. The feathers of the tail are attached in pairs to each vertebra throughout its entire length. It is in the form and number of the caudal vertebræ, and the arrangements of the tail feathers, that the great and striking peculiarity of this remarkable creature lies.

In all recent birds we find the tail very short and powerful, composed of vertebræ varying from five to nine in number, having spinous processes on their upper and under side, and

* The fourth toe bones underlie the second and third, and cannot be certainly counted.

† The fossil is lying on its *back*, so that we view *the underside* of its feathers and bones.

the last vertebra very peculiarly formed, and, with few exceptions, *always the largest*. To this last joint all the tail feathers in living birds are attached, and on it we find that peculiar oil-gland to which the bird applies its beak, and so anoints and renders waterproof every feather of its body.

Taking into consideration the remarkable divergence presented by the tail of this fossil creature from all known birds, and also the antiquity of the formation in which it occurs, we may at least safely infer that (if it be a bird at all) it represents perhaps one of the very earliest examples of its class.

And this seems the more consistent when we consider the analogous change which has taken place in the class of fishes.

For in the oldest fossil fish we find the same curious elongated tail (seen only in the sharks and sturgeon of the present day), in which the vertebral column is prolonged into the upper lobe of the caudal fin, forming the characteristic feature of the *Heterocercal* fishes. Whereas in the almost universally-prevailing type of modern fishes the tail fin springs from *the last joint* of the vetebral column, giving us the order of *Homocercal*, or even-tailed fishes.

That the feathers were real *bona fide* feathers like those of a bird seems to be placed beyond all doubt by the evidence of the impressions of both wings and tail, descending, as they do, to microscopic exactness. It has been suggested that a creature furnished with such feathers *must have had a beak* to keep them in order with.

Among the flying lizards of the Solenhofen slates is one described by H. Von Meyer, under the name of *Rhamphorhynchus*, as having "the *fore part* of each jaw *without teeth*, and probably incased in a *horny beak;* but behind this edentulous portion there are four or five large and long teeth followed by several smaller ones. The tail *long, stiff, and slender.*" Such a flying reptile *might have been endowed with feathers*, in which case the toothless portion, incased in a horny beak, would be well adapted for pluming and cleaning its wings and tail.

Such is the present state of the evidence. There is nothing in this fossil which elucidates the origin of the bird tracks of Connecticut, although perhaps contemporaneous with them.

Professor Owen decidedly inclines to the opinion that this curious creature is a bird, but many very distinguished naturalists, who have carefully examined it, have professed themselves unable to come to any such positive conclusion.

Much light may be expected from the Professor's promised paper, but we must wait for the discovery of other specimens before we can arrive at a complete demonstration of the true character of this wonderful inhabitant of a former world.

10*th Nov.* 1862.

THE ORIGIN OF INFUSORIA.

In a recent address on physiology, delivered before the British Medical Association, Dr. Sharpey said, "In the physiology of reproduction, the old question of spontaneous generation has been lately revived and submitted to further discussion; but, as I think, has been satisfactorily answered in the negative, and especially through the admirable researches of M. Pasteur. That most able and accomplished inquirer has not only proved the non-appearance of infusorial organisms when adequate means are taken to exclude their germs, but he has succeeded in actually demonstrating the presence of such germinal spores in the atmosphere. Air was made to pass through a tube filled with gun-cotton, taken from a sample proved to be free from foreign admixture. The cotton was then dissolved in ether or chloroform, and the sporules of algæ and other small organisms which had been entangled in their passage, were found in the liquid." In a former article, on the "Conditions of Infusorial Life," we gave a faithful account of the real state of this singular controversy, which is decidedly misrepresented by Dr. Sharpey's remarks. In the first place, it is not fair to M. Pouchet, the leader of the heterogenists, whose opinions we by no means espouse, to treat the contest which is eagerly pursued in France, and which has extended to America, as merely a revival of the old dispute about "spontaneous generation." The details of M. Pouchet's views will be found in his own work, *Heterogenie*, or in the article to which we have referred, and we do not intend to re-examine them now; suffice it to say that he reduces all generation to one principle, and conceives reproduction by eggs (*orthogenesis*), and reproduction without eggs (*heterogenesis*), to be the result of the same laws operating under different conditions. "If," says M. Pouchet, "a Supreme Being, whose unity is revealed in every part of the globe, has presided eternally and universally over all the phenomena that have been exhibited on its surface, and if it has pleased him to people the earth with tribes of animals and of plants that have succeeded one another, why not repeat to-day what has occurred in former epochs, for as P. Gorini observes, spontaneous generation is not a greater marvel than normal reproduction." M. Pouchet affirms in another passage that the same "Creative Will" which originally caused physical matter to assume living form, without the previous intervention of sexual elements, operates still. Thus both physiologically and theologically the modern controversy differs from the old, and it is only represented otherwise by those who would rather smother it under evil associations, than patiently wait for a result that can only be reached by much labour and thought.

As we stated in a former paper, the simplicity of the apparatus employed by M. Pasteur gives great value to his experiments, for it must be extremely difficult to shut out all sources of error, when a series of vessels with numerous joints are employed, but some of his opponents deserve equal credit for the method they have adopted. Practically the question to be first decided is, whether any vital organisms can appear in infusions in which existing germs have been destroyed, and to which the access of fresh germs is rigorously prevented. It has been assumed that boiling an infusion destroys any life or germ of life that it contains, and that when air is made to traverse a red-hot tube a similar result takes place. Now it cannot be said that, in adopting these methods, M. Pasteur has "*proved*" the necessary non-appearance of infusorial organisms, as Dr. Sharpey asserts, because opposite results have been obtained by other able experimentors who have made analogous trials. In France Messrs. Pouchet, Joly, and Musset, and in America Professor Wyman, adduce experiments that flatly contradict those of M. Pasteur. We gave some account of Mr. Wyman's experiments in number ix, p. 229, and they will be found in detail in *Silliman's Journal*, or in the *Chemical News* of August 30th. Several of these trials were made as described in the following extract:—"Two flasks each of 550 *c. c.* capacity, and each containing about 20 *c. c.* of beef juice and urine, were hermetically sealed at the temperature of the room, wrapped in cloth, and exposed for two hours in boiling water. The film formed on the fourth day. One of them was opened on the fifth, and the other on the eleventh, and both found to contain Bacteriums." In experiment 35, pieces of mutton in a hermetically sealed flask were boiled for ten minutes in a Papin's digester, under the pressure of five atmospheres. "No film was formed. The flask was opened on the forty-first day. Monads and vibrios were found, some of the latter moving across the field. No putrefaction, the solution had an alkaline taste." In four instances out of thirty-three no organisms appeared, but the balance of the results was discordant with those of M. Pasteur, Professor Asa Gray being present at the opening of some of the flasks. In experiment 12, the juice of an ounce of beef, to which was added 10 *c. c.* of urine and 40 *c. c.* of water, was boiled twenty minutes in a bolt-head and hermetically sealed. A film formed on the fourth, and the flask was opened on the eleventh day, when there was a distinct rush of air outwards. Large numbers of Bacteriums were found, also small spherical bodies with ciliary motions and oval bodies like kolpods, containing what appeared to be Bacteriums. One of these kolpod-like bodies moved with cilia.

After these experiments, it is obvious that there is some-

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thing else to be done than simply to acquiesce in the results of M. Pasteur, notwithstanding his scientific eminence and skill. Nor is it true, as Dr. Sharpey appears to conceive, that the presence of germinal spores in the atmosphere, sufficient to account for the appearance of infusoria in solutions, has been ascertained. M. Pasteur certainly discovered some spore-like bodies, but we believe he never identified any of them as eggs of infusorial animals. Professor Wyman states as the result of many examinations of dust deposited in attics, and of the particles floating in air and collected on glass-plates covered with glycerine, that like Pouchet, he found grains of starch, and spores of cryptogams, and much less frequently what appeared to be eggs of invertebrate animals, but that "both eggs and spores may be said to be of rare occurrence." It will, however, be asked whether the eggs of infusoria could be discoverd by the methods employed. M. Balbiani gives a table (which will be found at the close of this article) of the number and dimensions of the ova produced by various animalcules, and as will be seen on reference to our account of his remarks in No. 6, p. 468, he describes them as so transparent that their form can only be made out by employing dilute acetic acid to augment their cohesion and refractive power. It would probably be impossible, especially without the employment of reagents, to see those bodies after they had been caught in a film of glycerine, or still worse, in one of olive oil which MM. Joly and Musset employed, and we should certainly not be warranted in assuming the non-existence of infusorial ova in consequence of the failure of a comparatively clumsy means of investigation.

With reference to the appearance of Bacteriums or similar objects in infusions apparently free from living germs of any kind, we may observe that scarcely anything is known concerning these minute organisms. Ehrenberg placed them among the animals, and inferred their possession of a plurality of stomachs! Other investigators regard them as vegetables, and Mr. H. J. Clark, of Cambridge, U. S., claims some of them as nothing more than portions of decomposed muscular fibre or tissue. Probably these objects, which assume the form of exceedingly minute chains, more or less flexible and moveable, differ widely in their real nature, and some of them may not even be alive at all.

M. Pouchet now deposits with the French Academy a fresh batch of printed and MS. matter on Heterogenesis, to compete for the Alhumbert prize, and MM. Joly and Musset send in for the same purpose their *Nouvelles Etudes sur l'Heterogenie*, a brief account of which is given in *Comptes Rendus*, September 22, from which we select the most interesting facts. They took a series of flasks holding one litre, and containing forty grammes

of the same decoction, together with air that had been passed through red-hot tubes (*air calciné*). Then, following the method of M. Pasteur, they caused a little tube containing gun-cotton, charged with dust from the air, and "subjected to the action of burnt air," to fall into flask A. The neck of the flask, also filled with the burnt air, was sealed in a lamp. In flask B, prepared in the same way, they placed a piece of gun-cotton, selected from the middle of a considerable mass of that material which had been kept in a closed bottle, and was as free as possible from atmospheric dust particles. In C they placed the same decoction, with calcined air, and no cotton, while D was subjected, like the preceding, to a second ebullition, but was allowed to remain open. A fifth, E, was closed during the second boiling. After five days A was opened, and found to contain long Bacteriums, and a clot of a branching and entangled mycelium. This was the result obtained by M. Pasteur. B was opened two days later, and contained what the writers call dead Bacteriums reduced to granulations, and on a portion of the gun-cotton which extended beyond the tube there was a fine mycelium identical with that in A. C was opened on the same day with A, and exhibited Bacteriums, but rather fewer than A, and no mycelium. "This result," say MM. Joly and Musset, "confirms once more those which we obtained last year, in repeating the experiment of Schwann, and it proves, contradicting the assertions of M. Pasteur, that air heated and then cooled does not leave intact the juice of meat which has been exposed to ebullition. On the sixth day, D, which had remained open, exhibited no infusoria, but two days later swarmed with long and active Bacteriums. Eight days later E exhibited no infusorial life. Another set of experiments showed that distilled water containing a tuft of gun-cotton charged with atmospheric dust produced few organisms, and sometimes none; that similar water, to which a considerable quantity of dust was added, yielded Bacteriums and monads; that if aster leaves, carefully washed in pure water, were placed in distilled water, ciliated infusoria appeared. Distilled water used to wash a large quantity of mercury from a pneumatic trough "remained unfertile, although one of the enemies of heterogeny affirmed that a single globule of mercury was enough to people any infusion."

Following M. Pouchet, MM. Joly and Musset placed a considerable quantity of a filtered infusion of chopped hay in one vessel, and then floated in it a smaller vessel containing some of the same infusion. In the large vessel they obtained ciliated infusoria, and only Bacteriums and monads in the little one. It is not stated how long they kept these vessels to see what they would yield.

It is possible that after a greater lapse of time ciliated in-

fusoria might have appeared in the smaller vessel, as they can certainly be obtained with very small quantities of fermenting hay;* but if not, it does not follow, as these gentlemen consider, that the existence of germs in the atmosphere is disproved, as the small quantity of filtered infusion may not have contained enough of some particular substance to facilitate the development of any germs which might have fallen into it.

It is evident that controversies of this kind tend to clear up obscure points in the history of infusoria, and it is a pity that in England, as on the Continent, they cannot be regarded from a purely scientific point of view. It is not honest to take no account of facts that contradict our own notions, to cite Pasteur, and omit Pouchet or Wyman. As the matter really stands, there are discrepancies which have to be explained, and the vast assemblage of objects grouped together as "infusoria" differ so widely in structure as to countenance the idea that their mode of origin may not be the same. We may mention that the French Academy has appointed a Commission, composed] of M.M. Milne-Edwards, Flourens, Brongniart, and Coste, to report upon the papers on Spontaneous Generation sent in to compete for the Alhumbert prize.

THE EGGS OF INFUSORIA (*Balbiani*).

Name of Species.	Number of Eggs.	Diameter of Eggs in fractions of a Millemetre.†
Trachelius ovum	2	0·120
Amphileptus gigas (?) . .	20—25	0·018
,, anas	2	0·008
Loxophyllum meleagris . .	12—15	0·015
Loxodes rostrum	15—20	0·015
Chilodon cucullus	1	0·005—0·020
Bursaria truncatella . . .	4	0·057
Ophryoglena flava . . .	4	0·018
Spirostomum teres . . .	2—3	0·018
,, ambiguum .	20—50	0·014
Stentor cæruleus	8—15	0·021
Euplotes patella	2	0·014
Stylonichia mytilus . . .	4	0·018
,, pustulata . .	4	0·010
Urostyla (undetermined) .	100 or more	0·007
Paramecium aurelia . . .	4	0·018
,, bursaria . .	2—4	0·014
,, (undetermined)	20—25	0·007

* Mr. Slack tells us that he has obtained kolpods and other ciliated infusoria in vessels containing half a grain of chopped hay and two drachms of distilled water.

† The millemetre is equal to 0·0394 of an inch.

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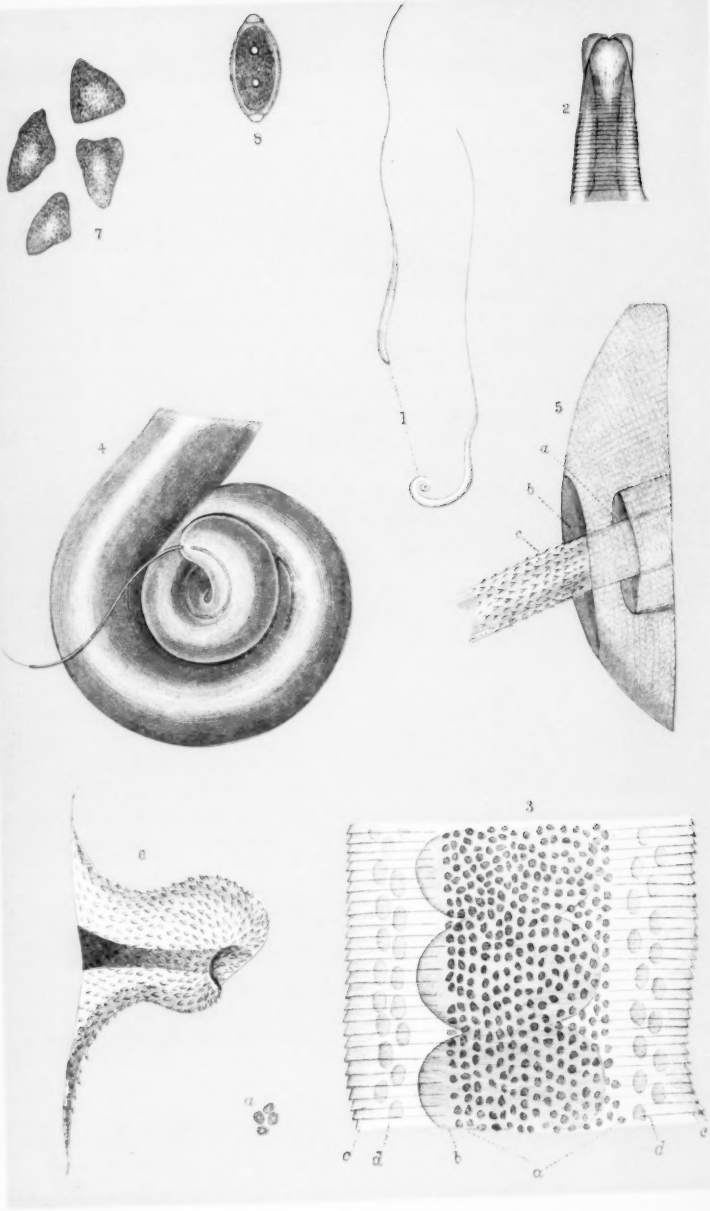
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THE WHIP-WORM.

BY T. SPENCER COBBOLD, M.D., F.L.S.,

Lecturer on Comparative Anatomy, Zoology, and Botany, at the Middlesex Hospital Medical College.

(*With a Tinted Plate.*)

A MORE appropriate name than the above could scarcely be devised for this interesting parasite. The species which dwells in the human body appears to have been first noticed by the distinguished Italian anatomist John Baptist Morgagni, and it was subsequently described by Buttner and Roederer, under the generic title of *Trichuris*, signifying *hair-tailed* worm. The circumstances which led to its rediscovery are thus recorded by Moquin-Tandon in (Hulme's edition of) his *Elements of Medical Zoology*: "During the winter of 1760-61, a student of Gottingen, who was dissecting the valve of the colon in the body of a young girl five years old, accidentally opened the cæcum, when several entozoa came out. H. A. Wrisberg and some other students considered that these worms belonged to a species not previously known. The prosector, C. T. Wagler, maintained that they were Oxyurides of a very large size. Other persons mistook them for very small Ascarides. From this a serious discussion, or rather quarrel, arose, which might have been easily settled if the newly-discovered worm had only been carefully compared either with an Ascaris or an Oxyuris. Roederer, having heard of the dispute, had the animal in question brought to him, and having examined it with Buttner, they both came to the conclusion that it was a new species." They accordingly named it *Trichuris*, under an erroneous impression that the long, narrow, filamentary part of the body was only the tail. All the species of the genus as now known display this remarkable character more or less conspicuously, and in some, as, for example, in the one selected for illustration in the accompanying plate (fig. 1), the thong-like portion of the worm is extremely attenuated.

As frequently happens upon the discovery of any novelty, all sorts of strange notions were soon afloat as to the significance of this new parasite, and consequently we find an otherwise intelligent physician writing a long dissertation, *De Morbo Mucoso*, with the view of proving that this perfectly harmless little whip-worm was the sole cause of a choleraic dysentery raging in the ranks of a division of the French army then stationed at Gottingen. Other crude ideas, unsupported by facts, were taken up and exploded in due time, whilst

the worm itself proved a puzzle to Linnæus and other zoologists. In 1782 that worthy German pastor and naturalist, J. A. E. Goeze, solved a number of difficulties respecting the structure, economy, and zoological relations of this parasite, and in his admirable *Versuch einer Naturgeschichte der Eingeweidewürmer thierische Körper*, we find him remarking as follows:—"The genus is rare. We have hitherto found this worm only in man, in a horse, in a wild hog, in a mouse, and in a footless lizard. From an examination of these, however, it is evident that they are not one and the same species, for they are not all similarly formed; but some, as that described by Pallas, are furnished with other organs. I make, therefore, two classes, as I have before mentioned, and in order that we should in future more agreeably recognize the Hair-head as *Trichocephalos*, I shall prove by undeniable facts that the capillary extremity is answerable to the head." From these and other observations of Goeze, it appears tolerably conclusive that he was the first to give a correct interpretation as to the true character of the narrow portion of the whip-worm. The various forms to which he alludes are now generally admitted to be distinct species; the one from the lizard (*Bipes Pallasii*) having been referred by Rudolphi to a distinct genus, under the title of *Sclerotrichum echinatum*.

Some eight or ten different species of Trichocephalus have been described by helminthologists; the two most common, and by their similarity of external characters likely to be confounded together, being the whip-worm of man and that of our domestic ruminants. The former (*Trichocephalus dispar*) has repeatedly been made the subject of minute investigation, but the latter (*T. affinis*) is comparatively less known, and its intimate structure little understood. We shall therefore confine our remarks principally to the species infesting cattle, and commence our special account of its peculiarities by offering a complete synonymy as follows:—

Trichocephalus affinis, Rudolphi; Gurlt; Miram; Lamarck; Mayer; Dujardin; Diesing; Cobbold (*Linn. Trans.*, vol. xxiii. tab. 33, p. 352).

Trichocephalus Cameli, Rudolphi.

Trichocephalus Ovis, Abildgaard.

Trichocephalus Giraffæ, Clot-Bey; Diesing (species inquirendæ).

Trichocephalus gracilis, Cobbold (*Proceed. Zool. Soc. for* 1860, p. 103).

From careful investigation we are satisfied that Clot-Bey's *T. Giraffæ* and our own *T. gracilis* are one and the same species, both being referable to the *T. affinis* of Rudolphi, which has now, therefore, been found in various kinds of oxen, sheep,

antelopes, and deer; in the goat, the giraffe, and also, according to Diesing, in the porcupine (*Histrix cristata*).

If attention be directed to the accompanying plate illustration, it will be seen that we have represented two individuals of *T. affinis*, the upper one being a female, and the lower a male, which is easily recognized by its gracefully curved spiral tail. To the naked eye these whip-worms do not differ materially from those found in our own bodies, but on microscopic examination a distinction, especially in the males, is readily observed. With the pocket-lens, as we have elsewhere remarked, the surface of the worm appears smooth throughout; but, when highly magnified, peculiar markings are seen on the anterior thin portion, which probably also extend over the body proper. The so-called neck presents a tolerably uniform thickness along its entire course; it is so narrow as to measure only from the $\frac{1}{1250}$ to $\frac{1}{1200}$ of an inch transversely, whilst the finely-pointed head itself, immediately below the mouth, has a diameter less than the $\frac{1}{1000}$ of an inch. In the fresh state the head appears to be lobed; or, rather, furnished with two alæform lobed appendages, as represented in fig. 2; but in preserved specimens these appearances either partially or entirely disappear, leaving one in doubt as to their true nature. Kuchenmeister has noticed the evanescence of apparently similar structures surrounding the mouth of *Trichocephalus dispar*, and therefore supposes that the lobes in question are due to the presence of a peculiar organ, capable of eversion and inversion, and not merely the result of accidental sarcode globules. Be that as it may, it is surprising to notice how completely other well-marked external and internal characters alter or disappear from shrinking and distortion caused by immersion in spirit. This observation especially applies to a very peculiar longitudinal band which commences a little below the head and can be traced on one side of the neck the whole way down to the beginning of the so-called body. This band, which is remarkably distinct in fresh specimens, was first discovered by Dujardin, who states it to consist of prominent and pointed papillæ. Wedl has also described it as consisting of little warts and spines; whilst Kuchenmeister goes so far as to compare these little prominences to the hooklets present on the intromittent organ of the male.

According, however, to our own observations, this band is made up of projecting, bluntly-pointed, polygonal, epidermal cells, which in certain adjustments of the focus refract transmitted light so strongly, that the band of them looks as if it consisted of a regularly arranged series of pigment spots, as shown in fig. 3 *a*; at other times the centre of each cell becomes clear (*a*), and the irregularly polygonal character of each individual cell is

rendered more apparent. On one side of the longitudinal band Dujardin also figures and describes a series of minute superficial papillæ, which he associates with a festooned border of the band. We have not observed these prominences, and the festooned markings are manifestly due to the subjacent convolutions of the œsophagus (*b*), being singularly uniform in size and disposition. In the fresh state the dermal rings (*c c*) are beautifully distinct. They are said to extend all round the filamentary neck, but we found them ceasing at a little distance apart from either margin of the longitudinal band. Midway between the latter and the serrated border of the neck there exists internally a double row of oval corpuscles (*d d*), but no vessels or fibres were observed in connection with them. As regards the reproductive organs, the first thing that strikes one is the unusual length of the intromittent organ and its membranous sheath. This character is believed to be distinctive; at all events, it departs very materially from what is observable in *Trichocephalus dispar*, where the sheath forms externally a funnel-shaped tube. The organ in question is also itself included in a sheath-like, muscular mass, apparently concerned in the evolution of the intromittent organ; its free end is shown in fig. 5 (*a*). We have never seen this muscle exserted, but the cloacal opening (*b*) is sufficiently capacious to give it free passage, if necessary. The everted part of the sheath (*c*) measures about the $\frac{1}{19}$ of an inch in length; being perfectly transparent, not always uniform in breadth, but covered throughout its entire extent with minute, conical, sharply-pointed spines, whose apices are directed backwards towards the body of the animal.

The occasional absence of uniformity in the diameter of the sheath seems to us to be a point of some importance; for, unless our examinations had extended over a considerable number of specimens, we might have believed ourselves to have found several distinct forms of *Trichocephalus*. At first this conclusion seemed inevitable; but, finding several intermediate conditions between that of a simple cylinder, on the one hand, and that of a tube furnished with a large flask-shaped distension near the free extremity on the other, it became evident that the variations of outline were only due to the degree of protrusion or contraction to which the organ had, in either case, attained.

To make these appearances clearly understood we have added a woodcut, which should be compared with fig. 4 in the plate, where the sheath is extended to the utmost. In the cut the corresponding letters have the same meaning in both figures, and they bear the following indications:—*a*, epidermis; *b*, cutis; *c*, cæcal end of the testis; *d*, seminal duct; *e*, intestine;

Fig: 1.

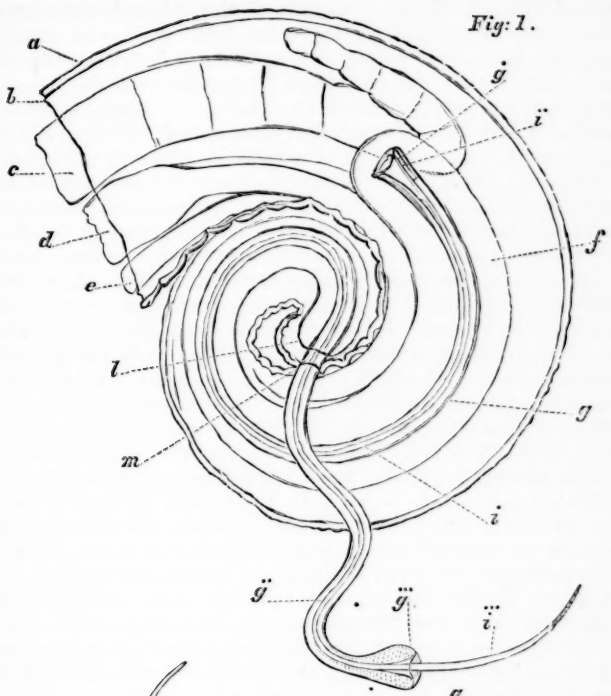
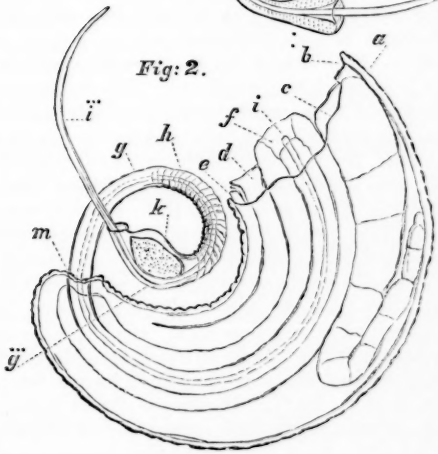


Fig: 2.



f, muscle surrounding the sheath of the intromittent organ, which latter is marked *g*; the same letter with one dot (*ġ*) marks the infundibuliform portion, whilst *g̈* indicates the exserted part of the sheath, which is armed with the minute retroverted spines; *g̈*, shows the flask, or cup-shaped expansion of the free extremity of the sheath; *h* (fig. 2), the rings formed by contraction of a portion of the sheath; *i*, the spiculum; *i̇* (fig. 1), the infundibuliform upper end of the same intromittent organ; and *ï*, its free pointed extremity; *k*, an oval mass of granules in one of the flask-shaped pouches, apparently consisting of spermatic particles; *l*, the cloacal cavity, and *m*, the anus. These two illustrations have been drawn with the aid of a camera from specimens prepared by ourselves, and mounted for preservation in glycerine. They are pretty objects under the microscope, from the graceful ammonite-like spiral which the tail of the male *Trichocephalus* invariably exhibits. When highly magnified, the free extremity of the spiculum is found to be scimitar-shaped, and rather sharply pointed. There were no markings on its surface, but we observed certain lines indicating the presence of a groove or tube, such as exists in *T. dispar*. In regard to the reproductive organs of the female, Kuchenmeister states that there are no external appendages in *Trichocephalus* comparable to those known to occur in the allied nematodes belonging to the genus *Trichosoma*. So far, however, from this being the case, there is in the present species, at least, a remarkably prominent, and more or less hourglass-shaped sheath projecting from the body (fig. 6); it is obliquely truncated at the free end, where it is also hollowed out, or rather, we should say, inverted, to give origin to the centrally inclosed vagina, whose orifice is somewhat constricted. The surface of this appendage is supplied with small spines, precisely similar to those described in connection with the sheath of the intromittent organ of the male, the spines being here also retroverted. These observations are confirmed by the previous statements of Mayer (*Zeitschrift fur wissen. zool.* B. 9, s. 367), but they have since been disputed by Dr. Eberth, of Wurzburg (on insufficient grounds we believe), in a later number of Siebold and Kölliker's *Zeitschrift*. We do not here propose to reconsider the controverted points, but pass on to remark that the ova, as in other nematodes previous to impregnation, are, at a certain stage, flat and irregularly triangular in outline; the thin limiting membrane by which they are surrounded inclosing finely granular contents, as seen in fig. 7. In the perfectly developed egg, the external capsule, chemically composed of chitine, presents the same characters as in *Trichocephalus dispar*; and at either pole of the ovum where the shell ends abruptly, an inner tran-

sparent membrane is seen projecting, in the form of a small mamillary process. This is shown at fig. 8, where the egg also exhibits the yolk undergoing segmentation, and two characteristic nuclei in the mesial line. When fully mature the ova have a longitudinal diameter of 1-340th to 1-320th of an inch.

Having thus dwelt at considerable length on the intimate structure of *Trichocephalus affinis*, it only remains for us to offer a few remarks on the present state of our knowledge respecting the development and migrations of this comparatively harmless species. In point of fact, we know little or nothing of the wanderings of this particular worm, but may legitimately infer the occurrence of certain habits from what we observe in the closely allied *Trichocephalus dispar*. Not long ago Kuchenmeister expressed his opinion, somewhat over confidently, that the little *Trichina spiralis* found in the muscles of the human body was the young of the last named species; but a series of beautiful researches by Virchow and Leuckart, carried on independently, have shown that this view is inconsistent with fact. M. Davaine has also recently applied himself to the determination of the development of *T. dispar* by direct experiment, and he finds that the embryonic formation only takes place within the egg after the ova have been expelled the host, and have been immersed in water for a period of about six months; consequently it may be surmised that either the mature ova or the escaped embryos gain access to our bodies in a passive manner when swallowed with the waters we drink. The subject, however, needs further investigation, and the experiments which we ourselves instituted on this score have hitherto only produced negative results.

ASPECTS OF NATURE IN SOUTHERN PERU.

BY WILLIAM BOLLAERT, F.R.G.S.

In order to illustrate some points of physical geography, I intend to take the reader to Peru, by the same route by which I went, namely, from England round Cape Horn, sighting its coast off Arica, in latitude 18° 20′ south. I had experienced every species of temperature and weather—the cold of a northern winter, the burning, blistering heat in the long calms of the equatorial regions, the frozen seas off Cape Horn; and one series of S.W. gales lasted several weeks, which drove us far to the S.E. with thick and heavy weather, so that when we went on the starboard tack, trusting to clear Cape Horn, on a certain night we got landlocked, a little to

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the west of the cape, on an iron-bound and savage shore, and within an ace of being wrecked there. However, although our captain had told us to prepare for the worst, kind providence and good seamanship rescued us from our perilous situation, and the following morning we slid past the island of Cape Horn into Nassau Bay, where we took in wood and water. Here we found large quantities of celery gone to seed (originally left by early voyagers), which was a pleasant addition to our peasoup.

I made the acquaintance here, for the first time, with the Red-Men of America; they were called on our charts the Red and Black Magellans, for as yet they had not been christened as Fuegians. I suspect they had been called red and black in consequence of their using red (oxide of iron) and black (charcoal) paint to their almost naked bodies. These miserable-looking creatures, although pure red-men, had a dark tinge, which I then attributed to dirt and the cold climate.

At last we get a favourable slant, running into the South Pacific Ocean, making a fair wind of the S.W. gales common in these latitudes, which soon carried us into warm, and then into hot weather.

Our latitude and longitude tell us we are approaching Juan Fernandez, or Robinson Crusoe's island; we sight it, continuing our course to the north, inclining a little to the east; till one evening a white elevation is seen in the eastern horizon; at daybreak, more white points are observed, and on the following day the mountains of the coast are beheld, and the next morning we approach the shore of Arica.

As we neared the coast, a high, dark, and escarped range of mountains rose abruptly from a placid sea; but when the swell found opposition to its onward course in the rocky barrier, it dashed against it sullenly, with a thundering noise, rising high up, curling round towards, and falling into, its native element, and spreading itself in rugged sheets of foam with a hissing sound. Ere it had died away, there was a repetition of the scene and sounds, that had something solemn in them, added to which not the slightest vegetation was to be seen.

We next came in sight of the "Morro," or headland of Arica, where this same picture of desolation presented itself. Yes, I am not ashamed to confess it, my heart sank within me; but there I was, and there I had to remain for awhile. I was too young then to suppose that I should ever find the least charm in a desert life. It cost me a few silent tears, and it was some time before I could realize my situation.

Here I met with the gentleman with whom I was to be associated in working some silver mines at Huantajaya, in the neighbouring province of Tarapacá; he was then and still is

known as Don Jorge, beloved by all who knew him. He had got used to these scenes, and his not quite so lively an organization as my own, had caused him to feel less in comparing the lovely verdure of England with this dark frowning and desert shore.

I geologized, I dug into ancient Indian tombs, examined with wonder the desiccated bodies of the children of the sun, the clothing of the dead, the gold, silver, and copper figures of deities, wonderfully-moulded pottery, and many other things; I botanized in the valley of Arica—for I found tropical plants growing in the bed of the river; I crossed the sandy desert to Tacna, botanized up its valley to the base of the Cordillera, taking note of its wondrous elevation. I looked at and examined the Indian of this locality, he was not the character I had pictured to myself; no, the three centuries of submission to the Spanish rulers had given even the young man an old and downcast look. I could scarcely believe that these were the descendants of those who had conquered for the Incas so much of the length and breadth of this land. If the country I was in was uncheering, the Indian was in conformity with it.

The present Peruanos are criollos, or descendants of Spanish parents; the mestizos are of the Spaniard and Indian female, the great majority being a mixed people, but I found them all kind and hospitable.

My friend Don Jorge had to remain awhile in Arica whilst I proceeded to Iquique, the port of the silver mines of Huantajaya. It was many years later that steamers were found plying along the coast from Panamá to Valparaiso; but the voyage from Iquique to Arica was not difficult, in consequence of the pretty general southerly winds and southerly current;* it could even be made in an open boat or a seal-skin *balsa* or float, and the only little difficulty likely to occur was an upset by a "school of whales," that come in shore at certain times of the year. The return, if by boat, was made during the night when the strong south wind had gone down, and what remained had veered to the eastward—this being the *terral* or land breeze; anchorage was found in some *caleta*, or cove, during the greater part of the day.

At the beginning of 1826, I embarked on board the balandra "San Miguel," for Iquique, with mining and other implements.

* This is sometimes called "Humboldt's current." In September, 1854, the "Guise," Peruvian man-of-war, during a calm of twelve hours, was drifted fifteen miles to the N.W.; so when sailing vessels get to leeward of a port hereabouts, they may be several days fetching into their destination.

On my last voyage to Europe in a sailing vessel, on a S.S.W. course, the third day from Arica, we got out of the cool water of this current, into warmer.

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This vessel was a small and rudely constructed sloop employed in the guano trade then carried on for the use of the coast only. Her trips were from the guano deposit of Pavellon de Pica, south of Iquique, to Arica and other ports to the north.

Since that period I have learnt not to be over-squeamish; but what I suffered from the sickening guano stench of the "San Miguel," I have a very vivid recollection of, even at this distant date. We had a twelve days' voyage, having to beat all the way; occasionally at night we got a favourable slant with the wind off the land, without which (having the current against us) our voyage might have been an interminable one, although only seventy-two geographical miles.

The coast was very bold and mountainous; not a tree or the merest sign of vegetation met the eye, and in this distance of seventy-two miles there were only two inconstant little streams, that came dribbling down from the Cordillera through the deep *quebradas* or gullies of Camarones and Pizagua, and they were always brackish, sometimes undrinkable. The next break containing a watercourse is one hundred and eighty-seven miles from Pizagua, where the river Loa flows, but its waters are sometimes as salt as brine.

On this voyage I was fully initiated into the living of the country on board ship. A tea of the Yerba de Paragua, sucked through a tube, very much like hot liquorice water; toasted maize in lieu of bread; the eternal greasy stew of not over-fresh jerked beef, pumpkin, potatoes, and garlic, condimented with the never-failing *aji*, or red capsicum, and this under calms and blistering suns! but how often have I wished for such fare whilst in those and other wild lands.

During the day the swarm of guano-making birds flying about was something prodigious, and their diving for fish (so very abundant in these waters) most amusing. Sometimes, when near in shore, the screaming of seals with the noise of the beating of the billows was anything but harmonious.

The monotony of my voyage was somewhat broken by meeting with an American whaler, who was busy cutting up and boiling a whale down. I went on board to dinner, but the effluvia there was rather more nasty, I think, than that of my own vessel.

One day being near the shore we let go anchor (a large stone in a wooden frame) in a cove. We had not long been there before I heard the captain and crew scream out "Misericordia!" and looking about saw them on their knees on the deck, devoutly crossing themselves and looking at me as I stood wondering, as if I really were a heretic. I asked the reason of this sudden act of theirs. "Temblor!" said they. I had indeedheard a slight rumbling noise, and then a sort of shake,

but had not attributed them to an earthquake; however, in time, I got as sensitive to such occurrences as the natives.

One evening we had a beautiful tropical sunset; it was magnificent, and the colours most brilliant. The day had been cloudless and the sun shining brightly; from gentle breezes it became a dead calm, and it appeared as if we were floating on a sea of glistening ultramarine; and as the sun was setting, the western sky, as if on fire, caused the sea to glow with its glorious reflections. The other portion of the heavens was tinted with light rose and lavender colours, blending harmoniously into one another; and then the changes were so rapid! We see all this wonderful beauty for an instant—in a moment it is gone, and we have to call upon a traitorous recollection for a faint description.

The arrival of the "San Miguel" was an event in the bay of Iquique. On one side was the rugged guano island, on the other high and precipitous mountains, and before us a small collection of the most miserable-looking habitations imaginable; in the rear huge sandhills, and beyond them mountains, mountains, desert mountains!

I was landed by a swift sea-skimming seal-skin *balsa;* the whole population, consisting of some dozen families, were on the beach to give me a welcome, and a thousand inquiries as to when Don Jorge would return, and when we were to begin working the mines of Huantajaya.

The occupation of the inhabitants of this desolate spot consisted in fishing and conveying imported provisions to the mines. Their miserable-looking habitations were built of rough porphyritic stone, cemented with mortar of burnt *sargasso,* or gigantic sea-weed, and sea-shells, and covered with mats brought from the north of Peru. The floors were of bare earth, and at one end was a raised part, which was the sleeping place; a small table and a stool was a luxury. The people appeared very happy, and even very kindly disposed, and seemed as if they were but of one family.

After I had got somewhat accustomed to this strange scene of the most absolute sterility imaginable, I used to wander in the cool of the evening from one habitation to another—*tertuliando,* gossiping and listening to their stories—they to mine. Having a medicine chest, a lancet, and tooth drawer, I very soon was called "El Señor Doctor"! and I think I may most conscientiously state that I never did much harm during my medical career, although I have had to attend to diseases I knew nothing about, and perform operations with similar intelligence. With comparatively harmless medicines I was not very particular as to the dose, but when I had to deal with calomel or strong chemicals like blue pill I was most careful.

I will now say a few words on the general features of the country.

The Peru of the present day stretches from 3° 35′ S. to 21° 48′ S. along the shores of the Pacific, a length of 1250 miles; its greatest breadth is about 750 miles, with an area of 512,122 square miles. After the revolutionary struggle, the Peru of the viceroys was divided into two parts, the one already alluded to, the other was called Bolivia, 700 miles in length by about 500 broad, three-fourths of which is a wilderness. Formerly it was called Charcas and Upper Peru. Its capital is in 19° 3′ S., 64° 47′ W., and known under the names of La Plata, Sucre, and Chuiqusaca.

The population of Peru is about 2,500,000, variously divided into Peruvians, white (the criollos of the Spaniards), and mixed with Indians (mestizos, or cholos, also with some little Negro blood), amounting to 900,000; Indians 1,460,000; Negroes 40,000, who are free, and as they can regulate their own amount of industry, have no inclination to overwork themselves, so large numbers of Chinese are imported to Peru as labourers, miners, and diggers at the Guano Islands.

Now as to the geographical division of the country.

1. The coast, which is rainless. On the north is the great desert of Sechura, on the south the still more extensive desert of Atacama. Some streams of water, the produce, principally, of the melting of snows and glaciers in the Cordilleras, run down steep and deep quebradas or dells, nourishing the bottom only of the valleys of the coast; for where water runs, there only is vegetation seen.

During the winter months of this region, on the lomas or summits of some of these mountains of the coast a peculiar vegetation appears, which will be treated of by and by.

2. The table-land. After a toilsome climb on mule back up the western slopes of the Cordilleras, and getting almost frozen to death, whilst going through the passes, some of which are over 16,000 feet above the level of the sea, and where a stunted vegetation has been long left behind, we descend to elevated table-lands, and of these the most interesting is that in which is situated the great Andean lake of Titicaca, 13,000 feet above the level of the ocean, and enlivened by its own peculiar fish. On the islands of this lake, and on its shores (besides the Incarial Temple of the Sun on the Island of Titicaca) are observed the stone ruins of Tia-Huanacu, some of the oldest monuments found in Peru; which even the Incas admired when they first discovered them.

Out of this Thibet of the New World rise aloft the ranges known as the Andes, from 22,000 to 23,000 feet high above the sea.

We now descend to the east, having had an opportunity, in one day, of reaching a region of eternal glaciers, with no vegetation, and a most difficult atmosphere to breathe, in consequence of its extreme rarity. The peculiar character of that atmosphere once seen is not easily forgotten; it is of so dark an indigo colour as to look nearly black, where stars can be observed shining at mid-day, and the white outline of snow on the ridges of the Andes and Cordilleras is in beautiful contrast with those sombre heavens.

In ascending the Cordillera the traveller may observe droves of the slow-moving and patient llama and alpaca; higher up he comes upon the timid, swift-fleeing herds of the huanaco and vicuña; in the table-land he may have met with a stray puma or even an ostrich from the eastern plains, but the only inhabitant of life he perceives at and above the elevation he has finally reached, is the mighty condor.

In the descent to the east the first vegetation seen is the curious and large dome-shaped, very resinous, yareta plant (a *Bolax*); then the *ichu* grass; this is the natural pasture of the auchenia or llama family, four in number; the vicuña and huanaco which are wild, the llama and alpaca which are tame. We come now upon cacti, the resinous Tola shrub appears, further down grasses cover the mountains, and in their ravines plants and small trees; and descending still further, tropical vegetation is arrived at, covering the tops of the mountains in this region down to the streams and rivers that flow into the Amazon and the Plata.

The silver mines of Huantajaya and Santa Rosa were up in the coast mountains, beyond which there was a great *pampa* or plain where the ores were amalgamated, in consequence of water being obtained from wells there. Further on was situated Tarapaca, the capital of the province, the residence of the *Intendente*, El Señor Coronel Don Ramon Castilla (now president of Peru), and there *terciana* or ague was endemic. Then there was another spot called Pica, where wine and brandy were made, but where the ague was of the *atabadillada*, or spotted fever type; further off still, lived the Indians in the valleys of the Cordillera, on their little farms, and higher up in the mountains they tended llamas and alpacas.

Now, in 1862, Iquique is a large place (the port for all that district, and second only in importance to Callao), containing from 5000 to 6000 souls, including a sprinkling of foreigners of all nations, churches, and some stately houses, a club, hotels —even an Italian opera has been performed there.

In early times the town was supplied with water from the *quebrada* of Pizagua, forty geographical miles distant to the north; now, all that is used for drinking is distilled from

the ocean, and sells for about three half-pence the gallon, realizing some £40,000 to £50,000; the fuel for this operation being taken from England or Chile. This great change from when I first knew the place is owing to the discovery and the refining of *Salitre*, or nitrate of soda, some few leagues in the interior.

Iquique stands on a thick stratum of shells near to the sea; on the shore they are in a fair state of preservation, but going inland they assume all the stages of disintegration, until where they touch on the rock of the country they are in fine powder, and on a dark night a slight phosphorescence may be observed in the shell-pits. Independent of mechanical disintegration, chemical changes have been going on, owing to some salt of the ocean having been left with the shells, and among them chlorides of lime, carbonates and sulphates of lime and soda (the last in very fine groups of crystals) are formed. Has this and similar sloping shell plains been elevated by internal forces of the earth, or has the sea retired? Perhaps the former is the more logical supposition.

The climate is so dry that, during a three years' residence there, I only once saw a very slight rain.

The mean winter heat at noon is 67°, the mean summer heat 80°, but in the sun it is scorching. Indeed, the coast would be unbearable on the score of heat if the winds during the long summer of this latitude were not the cool breezes from the south, and were not the climate further tempered by the cool current from the south, running rather rapidly at times along the shores of the Pacific.

The occupations of the natives, when not fishing (which took up but little time), were chatting and smoking. One day I asked an old fisherman, who appeared to me to be always smoking paper cigars, how many he smoked daily? He answered, forty; and this he had done for some fifty years. At the price then of these paper cigars, he had smoked £470 worth, and 730,000 cigars; and this for a ragged, shoeless fisherman! As the sale of tobacco and paper was a government monopoly, in these two articles alone what a tax on his luxury he had paid.

SUBMARINE ARCHITECTURE.

BY SHIRLEY HIBBERD.

WHEN Endymion saw "the giant sea above his head," he was in no better position for moral reflections on the perishability of man's work than we who sit in a small boat off Weymouth, perplexed for the moment by the abundant variety of objects just brought from the sea-bottom by the dredge. Endymion trod his way timidly among things

> "More dead than Morpheus' imaginings:
> Old rusted anchors, helmets, breastplates large,
> Of gone sea-warriors; brazen beaks and targe:
> Rudders that for a hundred years had lost
> The sway of human hand."

So we, probing amongst the sand and shells, and wriggling annelids, and fleshy lumps of Actiniæ, that have shrunk up in fear of the strange company and altered scene, have our thoughts turned aside from zoology proper by observing amongst the rubbish pieces of tile, chips of crockery, half-decayed nuts, a nail or two, and some other odd reminders of the earth and man which the sea has swallowed, to keep with other things until it shall have receded from these shores and left them buried with its own deposits of shelled and crusted forms, once living tenants of the deep. There is nothing, however contemptible to minds unschooled in observation, but may furnish a subject for thought and a theme for discourse not altogether aimless. As an antiquarian will deduce materials to fill up some old gap in history by the examination of an inscribed tile, so the odd findings of the dredge will be found equally fruitful in furnishing a stimulus to both inductive and deductive reasoning. Here is a piece of tile; *ergo*, it is the work of man. It is encrusted with colonies of serpulæ, and had it remained a few years longer in the watery depths, its shape, colour, and character would have been obliterated by the addition of successive deposits of the same kind, and Nature would have effected that object which she has always in view, the obliteration of the traces of man's art, and the appropriation to her own uses of whatever may fall from his hands. Precisely the same lesson is taught—so says Emilius, sitting at the stern of the boat, and looking with some sort of contempt upon the strictly zoological part of the gathering—by the findings of the dredge as by the exploration of a ruined city. The moment man lets go any product of his industry, Nature begins the work of disintegration. She dissolves, triturates, corrodes; or, if she cannot do either, she hides under a living garment the records of the dead past. But we tell Emilius that Nature does not

BOTTLE DREDGED AT WEYMOUTH, COVERED WITH ENCRUSTATIONS OF SEPULÆ, OYSTERS, ETC., ETC.

wait till man has bequeathed his works to her for resolution into their primary elements. She begins to grind a palace to powder the same day as it is built. The dew and the sunshine are as effectual for the purpose as any other of her agencies, but she does not waste while destroying. She simply appropriates, and so, to justify the decay of the marble column or the sublime statue that enchants the world, she plants it at once with green and golden mosses, teaches the ivy to pierce it with its soft teeth, and, when it has fallen from its base, and the rains have made a pool around it, she sends other ministers to bore tunnels through the mass, and others to clothe it with incrustations, so that it soon becomes wholly hers, for appropriation to new purposes.

Emilius wants to know if it is right to wander so far away from the subjects which gave rise to these remarks, when at the next haul we are presented with a treasure which makes us all forget our peculiar differences of taste and inclination, in admiring the beauty of a new illustration of the relations which may be established between the works of art and the works of nature. Broken bottles are frequently brought up by the dredge, and sometimes these are very beautifully incrusted with colonies of sea-creatures; but here is one complete. It may have been a champagne or a Scotch ale bottle—we cannot tell which—and the deposits on its exterior are more beautiful and varied than any similar example which has ever come under our observation. Here, we agree, is a prize worth the labours of the day—a prize, too, which interests us all, the zoologists and the moralists alike; and as our day's explorations have now come to an end, we discuss its merits and its history during the voyage home.

After removing some of the sand and slimy forms which cling about it, and then carefully laying it on one side in a vessel of sea-water that its numerous inhabitants may be preserved, we begin an investigation of the method in which it has been made so beautiful an example of marine masonry. It is smothered with Serpulæ, oysters, Balani, Lepraliæ, etc., and, whichever way we view it, we see myriads of trumpets, bird-beaks, tentacles, and siphons protruded from the cellular and tubular walls of this incongruous colony, which, like a city on a rock, has a very complete homogeneity in the close relationships of its various inhabitants. We call it the Acropolis, in the marine order of architecture, and the various inhabitants of the shells and tubes we liken to the trades and callings of the people of a terrestrial city. It is no easy matter to distinguish and determine the several species associated in this great colonizing enterprise, but time and patience will do much, and by degrees we make out a sufficient number to furnish a pretty fair idea of the

nature of the assemblage. We first of all notice particularly the Serpulæ. These form convoluted tubes in abundance, which are wreathed together and mixed up with other habitations in glorious confusion. Prominent amongst them is the noblest of the race, *S. contortuplicata*, the most easily identified as it pops up its feathery head and blows its coral trumpet in the midst of its meaner relatives, *S. triquetra, intricata, filiformis,* and *rugosa*, all of them abundant, covering the smooth surface of the bottle with tubular and angular constructions, and, in some places, running together into inextricable knots, the tubes overlaying each other, and leaving only just enough room for their several gill threads to peer out like the red faces of a crowd in the street, where the faces are all that can be distinguished. *Filograna implexa*, with its thread-like tubes, may just be identified in the midst of two distinct blocks of *Serpulæ*, but its scarceness is compensated by the crowded state of the masses from which myriads of gill fans are protruded. Equally conspicuous, though less attractive, are the oysters. I have since counted eighteen oysters in all upon the bottle. While in the boat, and our attention divided between inquiry and admiration, we agreed that, as regards oysters, it was "smothered;" a conclusion of far too sweeping and general a kind. Yet we were then not far from the truth, because after counting off eighteen distinct and veritable oysters, there remain some two dozen more little oysters of the size of split peas, embedded in masses of *Serpulæ, Balani,* and *Spirorbis*. But though less attractive still, because untenanted, we agree that the most curious elements in the construction are two shells near the base, firmly cemented and embedded in a mass of sponges and *Tubulipora*. How came they there? Were they attached during the life of the animals, or after the shells had ceased for ever the service they were ordained for in the individual life of the creatures? One of these is an old weather-worn valve of *Cardium echinatum;* the fellow-valve may be there below it, but is not to be distinguished amidst the mass of masonry of which the visible shell is the principal foundation. It is embraced at both edges by *Serpula contortuplicata*. *S. triquetra* doubles over and over like a miniature coil of rope, which the sea boy has confused, and will be sorely puzzled to restore to order; and at the margin it melts away all round into a mass of little oysters, *Membranipora,* and the remains of *Flustra, Terebella,* and sponges. The other is a shell of *Buccinum undatum* in a far advanced stage of disintegration. It lies far out from the base of the bottle, with its operculum cemented to the back of a large oyster-shell of six or seven years old. It is coated all over with acorn barnacles; the operculum is connected with the oyster-shell by a mass of sponge, and several commixed wreaths

of *Serpula contortuplicata*, among the windings of which are several miniature oysters. The spire is covered with patches of sponge, *Lepralia*, and *Balani*, and a sort of stippled marking in other parts of the shell indicate that some other colonies had commenced operations when we hauled it up, and arrested for a while the progress of the submarine architecture.

When we have made this general survey, and are still in doubt as to the genera and species of a few of the deposits, we ask each other in a chorus: "How is it done? who begins it? How is a hold first made upon the slippery surface of a glass bottle?" We take it out of the vessel, detach a few of the Actiniæ that have insinuated themselves between the folds of the Serpulæ, and turn it upside down. The hollow foot is as bright and clean as when the bottle was cast overboard by some party of merry yachters seven, eight, or ten years since. The sea water has not even corroded it, and the vitreous surface has an almost new look and polish. We reverse it, and peep inside. There, too, the surface glistens, and betrays no corrosion by chemical action, and the bottle is as empty as when it first left the glass works. Strange that no troglodytic anemone, no nereis or polyzoon is to be found there. Why should these creatures, that people the sea bottom in myriads, avoid the *inside*, and yet so love the *outside* of a champagne bottle? Does the discrimination betray a faithfulness to Neptune against Bacchus,—adherence to the good uncle, and a careful avoidance of the giddy nephew? No doubt the Serpulæ and Cirripedes have their likes and dislikes, and here is an example thereof.

When we drain the bottle dry, and examine it with a lens, we begin to understand something of the rationale of marine architecture. Every one of the larger tubes and shells rests on a foundation of deposits formed by some lower forms of life. Scattered over the surface are the remains of colonies of *Lepralia* of several species, amongst which *L. Pallasiana* may be distinguished by the form of the cells, as the most conspicuous. These patches thicken towards the larger attachments, and in nearly every case unite around them in unbroken masses, and form the foundations of oysters and serpulæ. There are other patches of *Nolella stipata* (Gosse) the orifices of which are imperceptible to the naked eye, but under a good lens easily discernible, each with its bell of tentacles, which by their quietude contrast prettily with the irritant beaks of the Lepralia. The rarest of this class of encrusting polyzoa are *Membranipora membranacea*, and *M. pilosa*, both of which appear in little detached rings, suddenly invested on one side with the outgrowth of some of the larger patches of Lepralia. Then mixed with these are masses of *Pachymatisma Johnstonia*

(Bowerbank) and *Halichondriæ* of species not determinable. Above these rise the conspicuous and characteristic shells of the *Balanidæ*, and these last mix and intermix in all directions as foundations and superpositions, but there is not one of the *Lepadidæ* to be found anywhere. The process of the superstructure appears then to be very much according to the order of the several creatures comprised in the colony; the lowest and the meanest, the Polyzoa, begin the work, the Cirripedes continue it, and the nobler Annelids and Mollusks take possession when the slippery surface has been roughened and the foundations of the city laid by their humbler predecessors. The proper elevation of the Barnacles to companionship with the Crustaceans proper, by Darwin, has a very pretty confirmation in the free and easy way in which they take possession of all sites, build anywhere, now on a foundation crust of true polyzoa, and now on the worn surface of an oyster, cockle, or whelk shell. There would be an end of the story, but we have yet to account for the attachment of the two mollusks last named in the short description of the species constituting this pretty colony. We know pretty well how serpulæ and oysters anchor themselves. Creatures capable of manufacturing calcareous shells from seawater can have little trouble in attaching them, and they appear to wait, before taking possession of a slippery substance, until the pioneers of marine colonization have prepared the foundation of the city. But how comes a whelk or a scallop to be mixed up with a mass of oysters, serpulæ, and barnacles, and to be cemented to the base of this bottle. It would be a greater puzzle were they found anywhere but at the *base*, but as they are at the base only we can easily imagine an old shell which has *drifted about for years at the sea bottom* coming at last in contact with the bottle and being involved in a busy mass of tube-forming annelids, getting involved in the cementing process, and so with them becoming attached. Is it possible the Cardium was dragged there by a hermit crab, then involved in the process of cementing by a young colony of serpulæ, and the hermit thereby compelled to quit for fear of being buried alive in his own habitation!

After all this Emilius is not satisfied. He has been testing our observations by experiences of his own in soundings for the Atlantic telegraph, and he detects, moreover, a few flaws in our reasoning. He says the Cardium is so cemented that he cannot understand how it should have become attached during the life of the animal. Would it, for instance, he says, be such a fool as to remain immoveable while a colony of tube-forming annelids laid their foundations, and fixed him secure for ever like a new Prometheus? No; both the Cardium and the Buccinum were surely lying untenanted on the sea-bottom

when the bottle sank slowly and in a perpendicular position, and rested upon them, and from that day to the present hauling up of the bottle by the dredge, the bottle *never once changed its position*. It has been proved, says he, that old shells never drift about the sea-bottom; there are no tides or currents there, but a profound stillness reigns as in chaos, though not lifeless. The deep sea-bottom is a place of eternal calm. Hereat he defiantly inverts the bottle again to remind us that there are no incrustations there, not even an abrasion of the smooth surface to show that after its deposition it ever once shifted from its place. The bottle evidently stood upright at the bottom, was undisturbed during the whole period of its submergence. The shells were already there, empty and decaying, in contact with its edge, and the cementing animals wrought between the angles of the contiguous surfaces, and soon cemented both together. We see no escape from these conclusions. Emilius is avowedly no naturalist, but he insists on logical deductions from all proven facts. We leave it to him to wind up the discourse, and he observes—

What a close analogy does this case afford to the method by which Nature appropriates the works of man on *terra firma*. The grass grows upon the rock or on the crumbling marble of the temple only after the surface has been prepared by successive colonies of confervæ, lichens, liverworts, and mosses. These form the foundations. As in the sea sponges and lepraliæ form a crust, so on the dry land the little liverworts form a stratum of soil which becomes a nidus for higher forms, and the humbler flowering plants follow and are succeeded by trees and shrubs. The 420 plants found by Dr. Deakin among the ruins of the Colosseum have an analogous position to the oysters and the serpulæ on our beautiful marine bottle. And to carry the analogy another step, when men build cities, they apportion to the humblest of their race, the miner, excavator, and mason, the task of forming the foundations on which noble forms of architecture are to be superimposed by skilful hands, and with all the aids of art and science. But in man's works the whole design is first prepared, the work of the miners and excavators is marked out as no less necessary, and as indeed the first essential for the erection of the fluted shaft and the capital, and when the city has ceased to be, Nature goes over *her* work in the old way, according to the vaster designs of the Great Architect, under whose guidance the meanest things perform services which are essential to the life of the noblest.

XUM

EFFECTS OF HASCHISCH.*

"UNDER the name of *Haschisch* is indicated the intoxicating preparations made from a species of hemp which bears the appellation of *Cannabis Indica*. The tops of the plants in flower, gathered before the maturity of the seeds, are employed in its production, but the details of the process are not known. It is prepared in two distinct forms—an extract shaped into slender cylinders more or less long, and thin tablets containing sugar, which have an agreeable and peculiar flavour. From the extract an alcoholic tincture is obtained, also *pastilles sucrées*, and several other preparations, in which fatty and aromatic substances enter. Sometimes the haschisch is smoked with tobacco, or it is mixed with coffee, tea, or other drinks.

"Haschisch is remarkable for a special action upon the human economy, which must not be confounded with that occasioned by alcoholic fluids, or by opium, and the general run of narcotics.

"Being desirous of testing its action on my own person, I seized, without hesitation, a favourable opportunity offered by one of my friends, who brought from the East a certain quantity of *haschisch* under the form of extract and *pâte sucrée*. I took two or three grammes of this paste with great indifference and doubt as to the marvellous effects it was alleged to produce. It was in the spring of 1854, about nine o'clock in the morning, and soon afterwards I repaired to the chemical laboratory of the College of France, and set to work as usual. In about a quarter of an hour I felt a peculiar movement in the extremities, which propagated itself towards the interior of the body. I felt as if something entered at the tips of my fingers and moved progressively, and without interruption, to my brain, without, however, producing the slightest derangement of the intellectual faculties, or the faintest impression of pain. I can only compare this sensation to that produced by nettles on the skin, or that occasioned by a great number of ants moving over the body, or that of a gentle titillation of the sole of the foot, or other delicate part of the skin. But all these comparisons are only approximations, and cannot convey a true idea of the effect produced by haschisch during the first period of its action. The movement I wish to describe has the peculiarity of being progressive, without intermittence, and without any pain.

"In this first period of the operation of *haschisch* I felt that I was in an abnormal state, and was contented. Nevertheless, I desired to continue the work I had begun, but was unable to do so, as my hands, affected by a peculiar nervous excitement,

* Note by M. S. de Luca, *Comptes Rendus*, 13th October, 1862.

refused to execute any movements that required delicacy or steadiness. I therefore determined to return home, but I had scarcely opened the doors of the grand court of the college than I beheld the houses as if they had been removed to a distance, while the voices that reached me were as weak as if they came from a remote place. All distances seemed very great, and I felt as if raised from the ground and walking through the air, whilst the persons in the streets touched the ground with their feet, as if they were my inferiors, and incapable of mounting above it as I had done. As I was hastening home the distances seemed to grow without end, and I thought I should never arrive. In the meantime I reasoned with myself and said, 'This is curious. The action of *haschisch* augments distances, weakens the voice, creates a sense of superiority over others, and the person under its influence believes himself lifted from the ground and walking in the air.' At length I reached the house, and at the place where my key was, I found and took possession of two letters bearing my address. The portress, who saw me return sooner than usual, said to her husband, 'M. Luca's rooms are not ready;' and when she heard me speak, she exclaimed, 'His voice has changed;' to which I hastened to reply, 'It is the effect of *haschisch*.' I proceeded to my lodging, opened the door, entered, and shut it, but left the key outside. My first desire was to open the two letters and read them, but the nervous movement which I have mentioned hindered me, and with all my efforts I only succeeded in passing them between my fingers and turning them about for two or three minutes. At last, seized with a supreme disdain for vulgar things, I flung the letters on the ground as if unworthy of my thoughts.

"A crowd of ideas came into my mind, and grew clear and precise; the nervous movement became more sensible, an agreeable feeling came over me, and I determined to go to bed, having taken off my clothes. I had scarcely got into bed before the clothes seemed to remove themselves to a certain distance from my body, as a sign of respect; and thus, without contact with them, I found myself in an atmosphere of pleasure and content. I saw at that moment, to my great satisfaction, all the events of my life pass before me; but my ideas changed so rapidly that I would not dwell upon a single one. At this time I said, 'If this state could last for ever, the dreams of poets would be realized, we should be all content, we should have nothing to desire, and we might pass our time in joyful contemplation!' The distinctness of my ideas was not diminished throughout this period of the action, and my mind sought to corroborate them by proofs, and to know them more completely. In fact, while I found myself in bed under this influence, I had

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my doubts, and said, 'You believe you are at home, and perhaps you are at work in the laboratory;' but this doubt passed off like lightning, as a thousand reasons occurred to convince me that I was really at home, and nowhere else, for I could get out of bed and walk—which I did; I could go back to bed—which I did also, having first examined my clothes, looked at the two letters on the floor, and noticed that the door was shut and the key outside. As soon as I got into bed the second time the clothes again removed themselves to a distance, and the same agreeable atmosphere surrounded me once more.

"This action lasted about four hours, and towards its close ideas succeeded with less rapidity, the distances diminished, and the bed-clothes respectfully approached me, the nervous movement disappeared, and all things gradually assumed their natural aspect, except that my lips were less moist than usual."

CARPENTER ON THE MICROSCOPE.

THE appearance of a third edition of Dr. Carpenter's well known and valuable work* is an important event in the annals of microscopic literature, in which it still occupies a foremost place. It may be confidently stated that, as a scientific introduction to the use of the microscope as an instrument of research, and to the natural history and physiology of a very wide range of objects, no work equal to it has ever been produced. The present edition, by the introduction of much new matter, the revision and correction of many passages written in a less advanced stage of knowledge, and numerous additions to the illustrations, is brought very closely up to the requirements of the time. The first portion of *The Microscope and its Revelations*, as in former editions, is devoted to an explanation of the optical and mechanical arrangements of various kinds of instruments; but while the great makers, whose productions cannot be too highly praised, meet with ample justice, there is a deficiency of information concerning the merits of their imitators, whose productions, if less perfect, may be obtained at a largely diminished cost. The comparative merits of first and second class object-glasses is a very important question for the student. If rich, he would be unwise to grudge the price of the finest that are produced; but if his means are moderate, it is important that he should have some idea of the results

* *The Microscope and its Revelations*, by G. B. Carpenter, M.D., F.R.S., F.G.S., F.L.S., Registrar of the University of London, formerly President of the Microscopical Society of London, etc. Third Edition. Illustrated by ten plates, and nearly 400 wood engravings. Churchill.

afforded by the assemblage of instruments at the late Exhibition, or by any other means of instituting an extended comparison of the operation of instruments of different kinds.

The most important addition to the microscope since Dr. Carpenter last wrote, is undoubtedly the binocular arrangement of Mr. Wenham, which marked an enormous advance upon the earlier methods adopted by that gentleman, or upon those employed in the more complicated and less serviceable form adopted by Nachet. At first the new binoculars were the subjects of exaggerated praise, and their admirers appeared to fancy that no one had ever seen objects in relief without their aid. These notions have by this time sobered down, and the binocular takes its permanent place as an addition to, not a substitute for, monocular patterns. To some observers its utility is much greater than others; those whose eyes are the best matched in point of focus and power being the best suited; while other persons—some eminent naturalists amongst them—do not find it of the slightest use. Most people, however, will be helped by it for certain objects, and will agree with the modified eulogium pronounced by Dr. Carpenter, who observes: "It is requisite to bear in mind, that as the special purpose of the binocular microscope is to convey to the mind the notion of the *solid forms* of objects, of which some parts approximate to the objective more closely than others, the rays proceeding from the most projecting parts cannot be so nearly brought to the same focus with those from the mediary, as to produce even a tolerably distinct image of both at once; and it is moreover to be recollected, that when high powers are being employed, and especially such as are of large angular aperture, the smallest departure from exactitude in the focal adjustment gives indistinctness to the image. It seems to be only with objectives of comparatively low power and small angular aperture that images most suited for the production of stereoscopic effects will be produced; but for certain classes of objects this mode of exhibition is admirably adapted."

Without depreciating the "binocular," we may remark that a still greater boon to science would be the construction of a microscope adapted to take in a very large field, so as to facilitate the study of marine and fresh-water animals or vegetables in an aquarium, or large zoophyte trough. It is extremely difficult to determine many interesting points of development unless the objects can be watched under circumstances that make them quite at home; and although Mr. Warrington's portable microscope can be brought to bear upon any vessel, it has the defect of instruments intended for minute investigation, and the field is not one-third of the diameter that could be advantageously used.

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The chapter on "Errors of Interpretation" is very important taken in connection with analagous remarks on the "Nature of Surface Marking of Diatomaceæ." Dr. Carpenter observes, "The most common error is that which is produced by the reversal of lights and shadows resulting from the refractive power of the object itself; thus the bi-concavity of the blood disks of human (and other mammalia) blood, occasions their centres to appear dark when in the focus of the microscope, through the dispersion of light which it occasions; but when they are brought a little within the focus by a slight approximation of the object-glass, the centres appear brighter than the principal part of the disks. The same reversal presents itself in the case of the markings of the Diatomaceæ; for these, when the surface is exactly in focus, are seen as light hexagonal spaces, separated by dark partitions, and yet when the surface is slightly beyond the focus, the hexagonal area are dark, and the intervening partitions light." While coinciding with the general reasoning, we would ask whether this passage does not require modification; cannot a hexagonal appearance be produced by illumination and focussing in objects in which it does not really exist?

Concerning these much disputed surface markings, Dr. Carpenter now says, that "There can now be no question as to the nature of the comparatively coarse areolation seen in the larger forms, such as Isthmia, Triceratium, and Biddulphia; in all of which the structure of the valve can be distinctly seen with a low magnifying power and ordinary light. In each of these instances we see a number of *areolæ*, rounded, oval, or hexagonal, with intervening spaces symmetrically disposed. . . . That the areolæ are really depressions is suggested by the appearances presented by the surface when the light is obliquely directed, and it may also be inferred from their aspect when viewed by the black ground illumination, since the areolæ are then less bright than the intervening spaces." After adducing other reasons, for the "depression" interpretation, the author passes to the consideration of the more delicate workings on minuter diatoms, and especially on those of the genus *Pleurosigma*, and he tells us when a *P. angulatum* is examined with an objective of one-twelfth of an inch focus, and an angular aperture of 170°, and a magnifying power of 1200 diameters, it presents a hexagonal areolation* somewhat resembling that of *Tricerstium*. We suppose other observers will still deny the accuracy of this hexagonal appearance, but the majority will probably coincide with Mr. Wenham's present opinion, and that now avowed by Dr. Carpenter, that the *Pleurosigma* areolæ "are minute tubercular elevations."

* There is some mistake here in the reference to Plate II.

There is another question on which microscopists would have been glad of somewhat more information. We allude to the practical value of such powers as Messrs. Powell and Lealand's 1-25th. Dr. Carpenter has only slightly modified the expressions previously applied to the 1-16th, that it is "questionable whether anything is really gained thereby," a dictum that is not confirmed by a subsequent statement that the 1-25th showed a certain movement in a plant cell not visible with other means. This power was likewise advantageously employed in the recent researches into the peripheral nerves made by Mr. Lionel Beale. The use of such high objectives must necessarily be very limited, and their employment without great judgment would only help to mislead. They may, however, be the means of explaining many particulars of extremely minute structure, and of elucidating the cause of movements like those of diatoms or the closterium, which yet remain a puzzle to be resolved.

Among the important additions to the present issue, we notice an account of M. Balbiani's discoveries on the reproduction of Infusoria—the first comprehensive view of which was given to the English reader in our own pages; a complete remodelling of the chapter on Diatoms, with explanations of the classification recommended by Mr. Ralfs; a collection of recently ascertained facts concerning the generation of the *Volvox globator*, showing that it forms no exception to the general rule, that bisexual propagation is a fact that occurs at some period of the history of an organized being. Moreover the account of the Rhizopoda has been re-written, and that of the Foraminifera enlarged and made to contain an exposition of the new views which have resulted from the labours of Dr. Carpenter, Mr. Parker, and Mr. Rupert Jones. There are also other additions of importance, including Mr. Rainey's remarkable discoveries of "Molecular Coalescence," of which drawings are given. These researches tend to connect purely physical with what are called vital processes, and Dr. Carpenter's remarks upon them will stimulate other inquirers to enter upon the path which has been so ably opened before them. Mr. Rainey brings about "a slow decomposition of the salts of lime contained in gum by the agency of sub-carbonate of potash. The result is the formation of spheroidal concretions of carbonate of lime, which progressively increase in diameter at the expense of an amorphous deposit which at first intervenes between them; two such spherules sometimes coalescing to produce dumb-bells, while the coalescence of a large number gives rise to a mulberry-like body." Similar concretionary spherules, Dr. Carpenter says, occur in the skin of the shrimp, in imperfect layers of the shell of mollusca, and they appear to form

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the deposits noticed by Professor Williamson in the scales of fishes; and it is "probable that by a further study of the relations between their structure and that of true bones and teeth, the principle of molecular coalescence will be found in some degree applicable to the special peculiarities of the latter."

Dr. Carpenter retains the opinions he has expressed on former occasions as to the distinction that separates the lower forms of animal and vegetable life, and considers we are "justified in laying it down as the most ready and certain differential character we are acquainted with, between those protophytes and protozoa which are apparently most closely related to each other in the simplification of their structure, that the former (with the exception of the fungi) decompose carbonic acid under the influence of light, and acquire a red or green colour from the new compounds which they form in the interior; whilst the latter, having no such power, receive animal and vegetable organisms, or particles of such, into the interior of their bodies, where they extract from them the ready-prepared nutriment they are fitted to yield." As we mentioned in our last number Dr. Wallich supplies some reasons for doubting the validity of this distinction as regards the deep sea Rhizopods, and the transformation of vegetable matter into the Amœboid condition seems to favour the opinion that no strict severance between the two kingdoms really exists. We must, however, wait before the full significance of the occurrence of vegetable Amœbæ can be ascertained. Dr. Hicks has not been able to give us a complete history of the Amœbæ formed from the protoplasmic contents of the roots of mosses, and Dr. Carpenter think that there is no sufficient evidence to confirm the statements of Dr. de Bary that the sporules of certain fungi (such as the *Æthalium septicum*) feed like Rhizopods, by taking in foreign substances, after they have assumed the Amœboid form.

We have spoken of Dr. Carpenter's book as an excellent introduction to the study of the various branches of microscopic investigation, but it must not be imagined by those who are unacquainted with the merits of former editions, that it bears any resemblance to that very unsatisfactory kind of literature which is usually described as "popular science." It is an admirable concentration of substantial learning and profound research, which could only have been made by an author whose own investigations had extended over an unusual range, and who possessed a rare acquaintance with the labours of other distinguished men. More than any book that could be named it will assist to form a class of genuine microscopic observers, and no intelligent person who can procure an instrument, need ever want objects to examine while its pages are at hand to indicate treasures that every locality can afford.

LASSELL ON AN ANNULAR NEBULA.

In a letter to M. Le Verrier, and by him communicated to the French Academy, M. Lassell gives the following interesting account:*—

"On directing my great telescope to the planetary nebula situated 20h. 56m., 101° 56′, its structure appeared to me so marvellous that I could not help sending you a drawing accompanied with a description.

"By employing two magnifications of 231 and 285, I saw, at first sight, an elliptical nebula of a clear blue, with a slight prolongation, or rather a very faint star, towards the extremity of its transverse axis. This aspect of the nebula resembled the appearance of the planet Saturn, when its ring is seen in a nearly full view. By employing still higher powers, magnifying respectively 760, 1060, and 1480 times, and under the most favourable circumstances, I discovered in the interior of the nebula, a brilliant elliptical ring, perfectly sharp, and without apparent connection with the surrounding nebula. This last is like a thin veil of vapour, and not confounded with the margin of the ring, whose splendour it diminishes very little. The nebulous envelope, a little more removed from the extremity of the conjugate axis than from the extremity of the transverse axis, is in reality very fully prolonged, and it is difficult to follow its traces amongst the stars that precede and follow it. There is a star near its northern border in the prolongation of its conjugate axis. The breadth or thickness of the ring differs from that of Saturn in being nearly uniform throughout. It appears, therefore, that if its form is really elliptical, we must see in a direction almost perpendicular to its plane; while if it is actually circular, it is presented to us a little foreshortened. A section passing through any portion of the space between its inner and outer sides would be circular. In other words, it is like a cylinder bent round till both ends meet.

"At first I was inclined to refer it to the same class as the annular nebula of Lyra, chiefly on account of its remarkable central star, which was, however, of greater brilliance; and, besides this, the resemblance is incomplete, for the ring is much more symmetrical, and better defined at its edges. It suggests the idea of a compact assemblage of brilliant stars, like the milky way. The brightness of the ring is not strictly uniform, the south preceding position being slightly more luminous. The transverse axis is inclined about 13° to the parallel of declination. A series of micrometrical measures of the length and breadth of the ellipse gives a mean of 26″·2 for the trans-

* *Comptes Rendus*, October 13th, 1862.

verse axis, and of 16″·6 for the conjugate axis." Mr. Lassell proceeds to remark that observations on this nebula are extremely difficult, and that it was only when the fine climate of Malta afforded him a night of unusual clearness, and permitted the employment of a power of 1480, that its details were revealed. He concludes thus: "I confess I was strongly impressed with the appearance of this marvel, situated, without doubt, at the extreme limit of the regions accessible to our investigation, and affording reason to believe that the heavens that are invisible to us are peopled with systems more splendid than any which we are permitted to contemplate."

LEECH-LORE.

BY THE REV. W. HOUGHTON, M.A., F.L.S.

Of the four orders which, according to Cuvier and Milne Edwards, form the extensive division know to naturalists by the term *Annelida*, that of the *Suctoriæ* most directly affects man either for good or evil. The various species that belong to the other three groups, viz., the *Dorsibranchiatæ*, the *Tubicolæ*, and the *Terricolæ* are only for the most part of indirect consequence to him, but with the leech, which belongs to the first-named group, man is directly concerned, and acknowledges this annelid either as a benefit or a pest; for while the medicinal leech has a strong claim upon our consideration on the grounds of the important services which it renders; there are others, such as the land-leech of Ceylon, and the horse-leech of Europe, which are often the cause of serious mischief.

Under the term leech is generally understood the animal of that name which is used in medicine, or rather, we should say, the two or three varieties thus employed; but the word is far more inclusive, and applies to other genera besides that to which the medicinal leech belongs.

Who was the discoverer of the useful art of bleeding by leeches? Themison, the founder of the ancient medical sect of the Methodici, and an eminent physician of Laodicea, in Syria (B.C. circ. 100), has the credit of being the first to make use of leeches.* The ancient Hebrews, and Orientals generally, do not appear to have been acquainted with the art, and even at this day the medicinal use of this annelid is unknown to the people of Syria; but that the art was practised by the later Greeks and Romans there is abundant evidence to show. We content ourselves, however, with one quotation from Oppian,

* Cæl. Aurel. *De Morb. Chron.* i. 1, p. 286.

who gives a very graphic description of the physician or surgeon applying leeches to an inflamed wound, the substance of which may be translated as follows :—

> "As when the surgeon, prompt and skilful in his art
> Has fixed a leech on some affected part,
> A leech, the slimy offspring of the pond,
> That sucks the black blood from each angry wound ;
> Nor stops, till satiated, with the gore,
> It drops from off the skin, nor thirsts for more,
> But coils upon itself." *

There are two kinds of leeches generally employed in medicine, viz. the *Hirudo medicinalis*, the gray leech, and the *H. officinalis*, or the green leech. Another kind less used, as it is considered to be of an inferior quality, is the trout leech (*Hirudo troctina*, Johns.), so called from the orange-coloured spots with which its body is marked. These three kinds may be taken as affording certain typical characters, but there are numerous varieties which offer slight differences in colour, which it is supposed may be the result merely of the nature of their food, or of the water which they inhabit. Leeches are imported to this country from Spain, the south of France, Hungary, Algeria, etc. Many millions are annually brought to the dealers, who are sometimes guilty of fraud in the sale of them. M. Moquin-Tandon tells us that the merchants divide the leeches into *small, middle-sized,* and *large*. The small are called "threads," those just born "sprouts," the very large one "cows;" he adds that the dealers often gorge the leeches before selling them, with blood from the slaughter-house, and thus convert the small ones into middle-size, etc. The medicinal leech was once common enough in the lakes and pools of the north of England, though it is very rarely to be met with now in those parts. In Wordsworth's sonnet, *Resolution and Independence*, we are introduced to an old leech-gatherer in the following lines :—

> "He with a smile did then his words repeat,
> And said that gathering leeches far and wide
> He travelled ; stirring thus about his feet
> The waters of the pool where they abide.
> Once I could meet with them on every side.
> But they have dwindled long by slow decay ;
> Yet still I persevere and find them where I may."

Wordsworth's sonnet was written in 1807; when we consider

* "ὡς δ' ὅταν ἰητὴρ πολυμήχανος, ἕλκος ἀφύσσων
οἰδαλέον, τῷ πολλὸν ἀνάρσιον ἔνδοθεν αἷμα
ἐννέμεται διερά τε γονὰς κυανόχροα λίμνης
ἑρπετὰ τειρομένοιο κατὰ χροὸς εστήριξε
δαίνυσθαι μέλαν αἷμα· τὰ δ' ἀντίκα γυρωθέντα
κυρτοῦνται, καὶ λύθρον ἐφέλκεται, οὐδ' ἀνίησιν,
εἰσόκεν ἀιμοβαρῆ ζωρὸν ποτὸν αὖ ἐρύσαντα
ἐκ χροὸς ἀυτοκύλιστα πέσῃ."—*Hal.* ii. 599.

the immense numbers used in *therapeutics*, we shall not be surprised that native leeches have now become very scarce, and there is little doubt that the enormous demand for them, not only in England but on the Continent, would in time completely exhaust the natural supply, were it not that art here steps in and stops the drain. Hirudiniculture, M. Moquin-Tandon informs us, is now a most important branch of commerce, particularly in the Gironde and other districts of the southern departments. Large artificial marshes are formed, and the water is kept at a uniform level; a supply of clay and peat is made at the bottom and on the sides, and aquatic plants are provided for the two indispensable requisites of oxygenating the water, and of affording facilities for the leeches to free themselves of mucus, without which necessary cleansing they cannot long be kept in perfect health.

Almost every one is familiar with the little triradiate shaped mark left by the leech on the skin. This is effected by the three teeth of the animal thus deposited in its jaws; each tooth is provided with two sharp saw-like edges, worked by powerful muscles.

The leech produces two or three fibrous-coated cocoons, in which are seen a number of *vitelli;* this takes place not in deep water, but in moist holes or drains, at the spring of the year. The whole process is doubtless a most interesting spectacle to witness, and though we have not ourselves been spectators of the *modus parturiendi* in the genus *Hirudo*, we have been fortunate enough to observe it in the case of a closely allied genus, *Nephelis*, a most common leech, in every brook and pool in this country. Every one who has turned over stones and weeds, and especially the broad leaves of *Potamogeton natans, Persicaria, Sparganium*, etc., must have observed some oval-shaped, olive-coloured bodies, about one-third of an inch long and two lines broad. You find them in every brook and pond in great multitudes all through the summer, fixed to stones and leaves, and within the stems of *Sparganium* and other aquatic plants. What are these? If you are puzzled, you may have satisfaction in learning that so was the great Linneus! At first he took these capsules to be a species of insect, to which he gave the name of *coccus aquaticus*. It is recorded of the great Swede, that when he discovered the true nature of these capsules, which for a time had so much puzzled him, he exclaimed, "*Vidi et obstupui.*" Linneus, however, does not appear ever to have witnessed *Nephelis octoculata* in the act of producing and depositing the capsule. It is to the late Dr. Rawlins Johnson, of Bristol, to whom science is indebted for having been the first to record this extremely interesting and curious observation. (See *Philosophical Transactions for*

1817.) As we have witnessed this process we shall briefly describe it.

Some few years ago, in the month of July, we had alive in a glass vessel three or four specimens of this leech (it is the only British species of *Nephelis*). A few days after their capture we observed that one individual which had attached himself and herself—for the leeches combine both sexes in one person—to the sides of the glass, appeared very restive and uncomfortable, twisting and turning about in every direction; by and by a constriction was observed to take place on either side of the orifice from which the eggs proceed, the space between these two constrictions being much bulged out; around the circumference of this portion a slimy sloughing of the skin took place, while at the same time a number of minute globular bodies were emitted from the orifice, and inclosed within this mucus-like formation. Then the animal, with hinder sucker firmly affixed, drew back the front part of the body, and slipped its head out of the jelly-like mass; and now a still more curious scene presented itself. The leech turned round, and with its mouth moulded this viscid secretion into that oval form which the cocoon is destined to assume, and fixed it firmly to the sides of the glass, leaving it for a moment, and then returning to the work. This continued for the space of two or three minutes, when the leech left the cocoon with its inclosed vitelli to be matured into young specimens of Nephelis in due time by the surrounding water.

The *Monographie de la Famille des Hirudinees*, by M. Moquin-Tandon, is a work of great merit, and contains a vast amount of information on every department of leech-lore, useful alike to the naturalist and the doctor. It is accompanied with an atlas of several plates, many of which are coloured, and contain, for the most part, faithful representatives of the animals; their structure, mode of increase, the diseases to which the medicinal leeches are liable, their commercial value, particulars necessary to observe in their application, the descriptive characteristics of the species of the various genera which comprise this interesting group of Annelida are all carefully discussed.

The species or varieties of the medical leech have a wide geographical range, being found in nearly all parts of the world, in Europe, in different parts of Africa, in East and West Asia, in North and South America, and in the Indian Archipelago, in hot countries and in cold, in lowlands and high ground; a fact which furnishes evidence, when considered in addition to that which results from its structure and natural habitats, of the leech being an animal especially designed to serve to the good of mankind. "On contemplating," says Rymer Jones,*

* *The General Structure of the Animal Kingdom*, p. 232 (1155).

"the singular dental apparatus found in the medicinal leech, and considering the nature of the food upon which it usually lives, it is difficult to avoid arriving at the conclusion that such a structure is rather a provision intended to render these creatures subservient to the alleviation of human suffering than necessary to supply the wants of the animals themselves. In the streams and ponds which they usually dwell, any opportunity of meeting with a supply of the blood of warm-blooded vertebrata must be of rare occurrence, so that comparatively few are ever enabled to indulge the instinct that prompts them to gorge themselves so voraciously when allowed to obtain it. Neither does it appear that the blood which they swallow with so much avidity is a material properly suited to afford them nourishment; for although it is certainly true that it will remain for a considerable time in its stomach without becoming putrid, yet it is well known that most frequently the death of the leech is caused by such inordinate repletion, provided the greater portion of what is taken into the body is not speedily regurgitated through the mouth."

The enormous consumption of leeches may well convince us of their general value. M. Moquin-Tandon, in, 1846, estimated the annual demand in France to be from twenty to thirty million. Paris requiring three millions every year. It would be difficult to name any other creature so low in the scale of creation that possesses such high commercial importance. The prices paid for leeches are subject to variation. In 1806 they were worth at Paris from twelve to fifteen francs per thousand; in 1815 from thirty to thirty-six francs; in 1821, during the winter, they were worth from one hundred and fifty to two hundred and eighty francs per thousand. M. H. Cloquet affirms that in America and in India the price of a single leech has been known to be as high as three or five francs and even a guinea. It has already been stated that dealers frequently gorge the leeches; on this Dr. Christison remarks: "The gorging of leeches is a more common fraud than the substitution of spurious species; they are known by being less velvety in their coat, less flat when pressed, and by presenting a little tumour when squeezed between the fingers from the head to the tail. Leeches which have been used are often sold for unused or 'virgin' leeches. These are best known by putting them on a white cloth, and dusting their fore part with finely-powdered salt. In thirty seconds a little blood will be emitted, but not a particle if the leech be quite fresh."

Leeches are caught in various ways. People wade into the water inhabited by these worms, and the leeches clinging to their naked legs, are thus picked off. They are taken by the hand or in nets. Women and children are employed in their

capture with great success. Sometimes portions of the bodies of animals are thrown into the water, and taken out after some hours with the adherent leeches; they are scooped out with ladles when the weather is rough, at which time they sink to the bottom, and hide in the mud. At Bonfarick, leeches are taken in great numbers by means of a wooden box, which is pierced on every side with a number of small openings sufficiently large to allow them to enter, but which are narrowed in the interior; this box is filled with moss and aquatic plants, and then, being attached by a cord, is thrown into the pond; the leeches collect in the plants. The spring is the season when the most leeches are taken, but the time varies according to climate. To prevent the complete exhaustion, the cocoons which contain the ova are carefully placed at the proper time in the reservoirs.

Leeches have enemies, and form no exception to the general law in the animal kingdom; various web-footed birds devour them, and herons, moles, shrew-mice, water-rats, and mole-crickets are also said to be their destroyers. It is related by Puymaurin that a certain dealer who had made 30,000 francs in four years by the sale of leeches, endeavoured to increase his number in a small pond, and when they amounted to about 200,000, a flock of wild ducks came, and in five hours destroyed them all. Besides these enemies above-mentioned, some kinds of fish, the larvæ of various aquatic insects, and even other kinds of leeches, such as *Aulastoma* and *Trocheta*, occasionally prey upon *Hirudo medicinalis*.

It has long been a subject of belief with some persons that leeches are so susceptible of atmospheric changes that they may be employed as useful barometers.*

A writer in *Hone's Every Day Book* (ii. 491) mentions the case of a gentleman who for several years kept a leech in a phial of water for the purpose of a weather-glass. If the weather was fine and calm, the leech lay motionless at the bottom of the vessel, and rolled together in a spiral form; if it rained, it crept up to the top of the glass; if wind was about to rise, "the poor prisoner galloped through its limpid habitation with amazing swiftness;" if a storm was at hand, the leech crawled up the glass and lodged out of the water, and "discovered great uneasiness in violent throes and convulsions."

On this subject M. Moquin-Tandon observes (213) that "on the eve of high wind, the leeches wander about their habitation with a surprising quickness; if the weather is cloudy they hide themselves in the mud; on the approach of storms they mount to the surface of the water, and fishermen profit by this circumstance to take them. These different movements are very far

* See *Inquire Within upon Everything*, No. 2180.

from being constant; if one observes a great quantity of leeches placed in a vessel, one would always perceive a number of these annelids remaining motionless at the bottom of the reservoir, and others rising to the surface of the water. However, a *curé* in the neighbourhood of Tours, announced in the public papers of 1774, that one could know every morning, by means of leeches, the weather of the next day. Briolët, Leroi, Toudouze and Valmont de Bomare, repeated these experiments and obtained no satisfactory results; Vitet was not more fortunate, and it has been the same with every one who has tried the employment of these pretended animal barometers. A modern author has therefore gone much too far when he has asserted that leeches replace with advantage the tube of Toricelli, and the opinion of the poet Cowper (as quoted by Johnson) is also exaggerated when he proclaims the instinct of leeches to be preferable to all the barometers in the world. It appears, however, that in Champagne, on the borders of the Lorraine, these clumsy instruments (*ces instruments grossiers*) had become common; a decanter, a small quantity of water, and five or six leeches being all that was necessary. Persons even carried their confidence in these indicators of the weather to the point of placing in the bottles a graduated wooden scale for the purpose of marking the different degrees of elevation to which the leeches attained. Charles Bonnet, who has perceived nothing regular or harmonious between the movements of the leeches and the variations of the atmosphere, has suspected that if these animals are not good barometers, they might serve as very sensitive thermometers; the assertion of the naturalist of Genoa is scarcely worthy of more serious consideration than the discovery of the *curé* of Tours." That leeches are, to some extent, affected by changes in the weather is a fact which we have witnessed ourselves, and where no other barometer can be had they can be employed in this respect by those who are not scrupulous about particulars or any amount of accuracy.

We all know how what is termed a *mania* in some particular subject breaks out from time to time, possessing the minds of multitudes with some epidemic. We all remember the Cochin China *mania*, the aquarium *mania*, for instance, but what will the fair sex say to the fact that in 1824 there existed in France a leech mania! The most enthusiastic admirer of Cochins, or of sea anemones, would never have thought of carrying her admiration for her pets so high as to wear on her dress representatives of these animals; but we learn from Fée that there might have been seen at that period elegant ladies wearing dresses *à la Broussais*, on the trimming of which were mitations of leeches! M. Broussais was a physician, no doubt the great patron of leeches, as Mr. Gosse is of sea-anemones.

The following extract from M. Moquin-Tandon's work, *Elements of Medical Zoology*,* may be read with advantage by those interested in checking the threatening scarcity of an animal whose preservation is of so much importance to all classes of society:—"M. Vayson has recently suggested a small domestic marsh (a *vaysonier*) which will be exceedingly useful to the pharmaceutist, and to persons who are desirous of raising *leeches* on a small scale. This apparatus consists of a common earthen vessel having the form of a truncated cone reversed. The lower part is perforated by a number of holes, but not so large as to allow of the leeches passing through them; the vessel is then filled with peat earth, and a number of leeches are placed upon it which embed themselves in the earth; the upper opening of the vessel is then covered up with a piece of coarse canvas. When it is desired to send the leeches to a distance, the earth is made as damp as possible, and the vessel is packed in a box or wicker basket. When it is only wanted to preserve the animals, the lower part of the vessel is placed in water to the depth of about four inches, and the creatures are left to themselves. In consequence of the infiltration, the lower parts of the peat are soon saturated with water, while the upper portion is almost dry. The leeches know perfectly well how to choose between these two extremes the layer which is best adapted for them, and form in it galleries in which they live, grow, and produce their cocoons. The *vaysonier* will answer both for the preservation, the conveyance, and reproduction of leeches."

There are interesting particulars relating to many other genera of the leech family, such as the horse-leech, the land-leech of Ceylon, the incubating leech (*Glossiphonia*), but space forbids further remarks.

* Translated and Edited by R. T. Hulme. London. 1861.

THE STRUCTURE AND HABITS OF PHYSALIA.

BY G. C. WALLICH, M.D., F.L.S., F.G.S.

THE last number of the INTELLECTUAL OBSERVER contained a summary of the researches of the older writers on Physalia, from the time of Alexander when it was first noticed by Aristotle as occurring in the Mediterranean, to the year 1843, in which we find it described by M. Lesson in his *Histoire Naturelle des Acalephes*. But, although the more obvious portions of the Physalian structure had already been described at the date of the last-named memoir, it remained for our distinguished countryman Professor Huxley, to advance our previous knowledge of the Oceanic Hydrozoa generally, and to correct many of those erroneous views regarding their organization and morphological relations which were due to the statements of De Blainville, Lesson, and others.

It is the object of the present paper to adduce what further information has thus been rendered available, and, at the same time, to put the reader in possession of some apparently novel facts bearing on the history of Physalia which have fallen under the writer's immediate observation.

Professor Huxley's first memoir on Physalia was forwarded by him in 1847, from the Australian Seas, to the Linnean Society; the more detailed account appearing, however, in his admirable work on *The Oceanic Hydrozoa*, constituting the volume published by the Ray Society for the year 1858.

We find it there stated that "the body of every hydrozoon is essentially a sac, composed of two membranes," an external and an internal, which have respectively been called the "Ectoderm" and "Endoderm."* This sac contains the nutritive fluid which performs the functions of the blood in the higher animals, and is circulated by means of cilia which generally invest the inner as well as the outer membrane and, aided by the muscular contractility of the body, constitute the only circulatory and respiratory mechanism in the organisms under notice. The two membranes may readily be traced in every part of the structure. In the large bladder (which, by the way, closely resembles the swimming bladder of a medium sized haddock in dimension and general outline) they form an outer sac, or "pneumatophore" as it is technically termed, within which the true air-chamber, or "pneumatocyst," is enclosed; the latter being in reality a secondary introverted sac, having the same structure in its walls, and communicating with the outer world by a minute contractile orifice at the point at which the

* By Professor Allman.

inflexion of the pneumatophore or outer sac takes place. This point corresponds with the apex of the more elongated extremity of the pneumatophore. It will thus be seen that there is no communication between the cavity of the pneumatocyst and the general cavity of the organism; but, on the other hand, that a free communication does exist between the general, or "somatic" cavity as it is called, and the space existing between the walls of the pneumatocyst and pneumatophore.

According to Eichwald* and Von Olfers,† the crest is formed of a series of vertical cæcal folds of the pneumatocyst, invested exteriorly, in common with the rest of that body, by the two membranes of the pneumatophore. It is extremely doubtful whether the Physalidæ possess the power of expelling the air from the air-chamber as asserted by some writers. The only reliable evidence of this process is adduced by Eschscholtz,‡ who describes having seen the air voluntarily expelled from a young specimen of Physalia only five lines in length, so that it immediately sank to the bottom of the glass vessel in which it was placed for observation. In the nearly-allied families of Rhizophoridæ and Physophoridæ, in which the pneumatocyst consists only of a minute spherical or pyriform vesicle, I have repeatedly seen the creatures suddenly sink to the bottom of the glass on being irritated, but without any appearance of collapse of the air-cell. In the young Physalidæ the character of the air-cell ("pneumatocyst") is identical with that of the adult Physophora and Rhizophora, but no amount of irritation ever caused the specimens to contract the air-cell or sink, although their polypites and tentacles exhibited sensibility to the slightest touch, or even vibration of the glass, by becoming instantly coiled up close to the body.

During the long-continued calms at the equator, extending sometimes over several days, when the surface of the sea is literally as smooth as a mirror and as pellucid as crystal, I have had ample opportunity of watching Physalia, and have in no instance observed the float collapse, or the creature sink beneath the surface. Under the above conditions it becomes manifest that the creature is wholly devoid of power to move to and fro; the individuals remaining, as it were, fixed in the same spot, and evincing no signs of vitality beyond a partial collapse of the crest, occasional abrupt changes in the direction of the axis of the pneumatophore after the fashion recorded by M. de Quatrefages§ and Professor Huxley (*loc. cit*), a gentle dip over on one side—probably with a view to moisten the surface

* *Mem. de l'Acad. Imp. des Sciences de St. Petersbourg*, 1824.
† *Abhandlungen de Kön. Akad. de Wissenschaften zu Berlin*, 1831.
‡ *System du Acalephen*, 1829.
§ *Annales des Sciences Naturelles*, 1853.

which must become more or less parched by the fierce rays of the tropical sun,—or a few lazy oscillations in answer to the never-ceasing swell of the ocean. These are the only movements which present themselves during calms, but a far more remarkable phenomenon has repeatedly been noticed by me in moderate weather when the ship is passing along at a speed of not more than three or four knots an hour, and its impetus is sufficient to transmit delicate undulations for some distance along the surface of the water, although there is not sufficient wave-action to interrupt observation. Under these circumstances, each Physalia, as it comes abreast of the ship, even when at a distance of from thirty to sixty yards, gently inclines its pneumatophore and crest to one side so as to rest laterally on the water, and only regains its original posture when the ship has advanced far enough to prevent the transmission of the undulations. That the sensibility to the mechanical disturbance thus produced at the surface of the sea must be intensely acute is evident, inasmuch as the effect is visible far beyond the range of any surface disturbance observable by the eye. Hence it would seem to be aroused, not by the ordinary wave-action by which the creature happens to be surrounded, but by the subtle abnormal character imparted to that action by the passage of the ship. It is hardly necessary to state that, since no nervous system can be detected in the Physalidæ, there are, at present, no data even for speculation on the physiological aspect of this highly curious phenomenon; and it must be obvious that any attempt to account for it on the supposition that the acts in question are the result of direct mechanical irritation, is simply substituting one unexplained fact for another. At present, therefore, I have only to record the act of the "Portuguese man-of-war" as one of very frequent occurrence, leaving it to more imaginative minds to trace back the existing mode of salutation between vessels at sea designated "dipping the colours," to this primæval source.

According to my own experience, the Physalidæ never sink below the surface as has been asserted, but merely become lost to sight in the wave-disturbance when the weather is stormy; their peculiar colour and bubble-like aspect causing them to be undistinguishable from the element by which they are surrounded when at any distance from the observer's eye. This view derives confirmation, moreover, from the fact that they are frequently entrapped by the towing-net when not a single specimen can be seen, owing to the reason assigned.

The inclination to one side and re-erection of the pneumatophore, to which reference has been made, is slowly performed, (each operation occupying from three to five seconds) and would seem to be effected by the contraction of the muscular wall on

the side towards which the inclination takes place. Besides this, the creature has the power of raising up, into a nearly vertical position at times, the free extremity of the pneumatophore. Even when taken out of the water, and placed on any hard surface, this portion of the creature continues to move, thus indicating that the act is due to muscular contractibility of the walls of the air-chamber, and not to the mere change of axis, alluded to by M. de Quatrefages, which is due to the sudden contraction of the tentacular appendages now about to be described.

On the inferior surface of Physalia there exists what appears, at first sight, to be only a confused mass of tentacular and suctorial organs. This mass consists of a duplicature of the general substance of the body, termed the cœnosarc by Professor Huxley, from which three kinds of organs are given off, namely, the "Polypites," the "Tentacles," and the "Hydrocysts." The first are variable in number and size, and, according to the author just named, constitute the "principal organs of alimentation." In outline they are somewhat pyriform or flask-shaped, and during the life of the creature are in continual motion; the broad open discoidal end being that which is dependent, whilst the short pedunculate extremity is that by which they are attached to, and communicate with, the cavity of the cœnosarc. Although these organs serve the purpose of stomachs, they also possess the prehensile power imputed to them, as may readily be seen in specimens placed in confinement. The interior of the polypite is furnished with villous projections, by means of which digestion and absorption are said to be effected, and the nutritive products conveyed into the general cavity of the body. The hydrocysts, which differ in no aspect from the polypites, save in being completely closed externally, have been regarded by Professor Huxley as "young stomachs."

The tentacles, in like manner with the polypites, are variable in number and length, one being, however, generally much longer than the rest. Each one is furnished at its point of attachment with a jelly-bag-shaped sac, the mouth of which communicates with the general cavity, and, along its upper half, with that tentacle to the side of which it is adherent. The tentacles in their contracted state are only a few inches in length, whilst, in their extended condition, they often attain a length of from four to six feet. They are formed of longitudinal highly contractible fibres, each of which averages from $\frac{1}{2500}$th to $\frac{1}{1700}$th of an inch in diameter; the united fibres, when extended, constituting a flattened band somewhat thicker on one side than on the other, along which are attached at intervals, crescentic masses composed almost wholly of thread capsules.

These masses do not embrace the entire circumference of the band, but only three sides as it were; the fourth being left free along its whole length. It is in the thread capsules that the peculiarly acute stinging power of the Physalidæ resides; although, as yet, both the chemical composition and the mode of secretion of the poisonous fluid with which the threads are embued, is altogether unknown. It is almost certain, however, that the extension and contraction of the tentacles is attributable to its own muscular structure, and not to the injection of the poisonous fluid supposed by Lesson and others to be a secretion of the basal saccular appendage already referred to.

The extensile quality of the tentacle is very remarkable. Thus I have repeatedly succeeded in winding it on a card by merely placing the animal on a board during the operation, and reeling off the thread, which, by this means, is reduced in thickness to that of fine silk, and may be continuously wound until it attains a length of eight or ten yards. This filament, when dried in the sun, will keep for any length of time, and forms a beautiful object for the microscope; the fibrillæ of the muscular band and the crescentic bundles of thread-cells being admirably seen, whilst their original colour is in nowise destroyed.

My endeavours to preserve the pneumatophore by drying in the sun, were invariably unsuccessful for, although it remained distended and its upper and lateral portions acquired the tough consistence of a dry membrane, the setting in of decomposition along the inferior fleshy portion always ended in its rupture. Small specimens of the allied family of Velella, however, which were preserved on glass slides by a similar process of drying, in 1857, are still in my possession, together with the delicate tentacles of Physalia just alluded to.

Although there cannot be a doubt that nutritive organisms, probably consisting of minute Entomostraca, Infusoria, or Rhizopoda, are seized after having been paralysed by the urticating organs of the tentacles and polypites (for these bodies also occur in the latter appendage), there is, I think, good reason to suspect that Mr. Bennett, who describes the process of fish capture by a Physalia, must have been misled as to the cause and effect of what he witnessed, for the following reasons: In a great number of cases the Physalia is accompanied by one or more small fishes, precisely in the same manner that the pilot-fish accompanies the shark. These fishes swim round and round and through the depending tentacles without inconvenience, and their association with Physalia is undoubtedly one of choice, being in all likelihood due to the quest of some kind of food which is attracted towards it, or furnished through its excretions. I have so repeatedly witnessed this association,

and captured both Physalia and fish in the small hoop casting-net I was in the habit of using, that I can confidently state there is no hostility between them under ordinary circumstances, and that the mere contact of the fish with the tentacles of the former does not result in any observable inconvenience to either animal. The fish (according to Dr. Günther, who very kindly examined my sketch and favoured me with his opinion) is probably either a young form of one of the Scombridæ, or, if mature, a member of some unknown genus. It is curious, however, that the specimens captured by me over a wide area of the Atlantic, invariably belonged to the same species, and were, as nearly as possible, of one size; that is to say, from two to three inches in length; the colour on the back being a deep blue, identical with that of the cænosarc and body of the polypites of Physalia. Nor was this fish the only attendant on it; for, crawling about within the mass of polypites and tentacles, I as often found several Isopod crustaceans, from a quarter to three-quarters of an inch in length, evidently parasitic in this position. The same species was also observed by me frequently on the float of Ianthina, and on floating epiphytic Lepadidæ. Here, again, it is clear that the urticating organs are innocuous, inasmuch as partially devoured or dead specimens were never met with.

Lastly, I have not observed the marked iridescent quality which has been stated to accompany the brilliant tints of the Physalidæ. The colours themselves are extremely rich, the contrast afforded by the roseate pink of the upper margin of the crest, and the graduated tints of blue, commencing with the faintest opalescence on the upper surface of the pneumatophore, to the deep and almost full-toned indigo of the cænosarc and appendages, being very striking. Intermixed with these colours are the greenish streaks which mark the outlines of the cæcal chambers of the crest, and the root-like continuations of the velvety dark-coloured mass beneath. The minute mammiliform protuberance at one extremity of the pneumatophore is also of bluish green, whilst the walls of the air cavity itself, although almost colourless, reflect the images and tints of passing objects in the same manner as a soap-bubble, but without any greater amount of iridescence than is perceptible in ligament.

Of the mode of development of the embryo and of the air-chamber in the Physophoridæ generally, nothing is at present known; the young Physalia having only been seen when already so far advanced in growth as to constitute a nearly perfect, though comparatively minute, individual. In like manner we have still much to learn regarding the true basis of specific distinction in this class of organisms; the older authors having

adopted distinctions which now-a-days would hardly be admissible as indicative of varieties.

These, then, are the more prominent characters of this remarkable and beautiful genus of Hydrozoa. They have been given somewhat in detail, with a view to incite "those who go down into the sea in ships" to extend our knowledge; and to prove that, at all times and under nearly all circumstances, the voyager may find ample food for the mind, and a far from exhaustible field for the instruction of his fellows.

PROFESSOR LAMONT'S NEW THEORY OF ATMOSPHERIC VAPOUR.

BY ALEXANDER S. HERSCHEL, B.A.

The experiments of Dr. Dalton on the pressure of vapour rising from the surface of water at different temperatures, in free space and in space enclosing air, led to conclusions which have since been received by the compilers of meteorological tables, but which are questioned by M. Lamont, and shown by his experiments to be in some degree fallacious. The vapour of boiling water, or of water at 100° centigrade, is familiarly known by the vibrations of the lid of a kettle, and by the formation of bubbles upon the surface of the heated water, to have the pressure of the incumbent atmosphere. The bubbles which rise to the surface of water boiling in an open vessel enclose within their pellicle a vapour whose tension or elastic force is exactly equal to that of the equally heated air which surrounds their envelope, and burst so soon as the quantity enclosed exceeds a capacity proportioned to the thickness of the film. The experiments of Dalton proved that the vapour so enclosed was lighter than the air surrounding, in very nearly the proportion of 2 to 3. It follows, by Mariotte's law of equable expansion of gases or vapours by heat, that such vapour and such air exposed to any superior equal temperature, will have to each other the same proportion, in density, of 2 to 3; but a further deduction from the experiments of Dalton is this, that water boiled in a partially exhausted receiver of air, will give rise to bubbles which enclose a vapour having equally a proportion in density of 2 to 3 to the adjacent air. In short, the vapour of water and common air, wherever these subsist at a common temperature and pressure, are always in the proportion in density of 2 to 3 one to the other. We here consider the case of water boiling in air. The pressure of the incumbent air being in this case the exact measure of the elastic force or

tension of the vapour emitted by the water at boiling temperature, a table is readily constructed to exhibit the vapour tension of water of given temperature. Conceive a globe, completely exhausted of air, to contain a quantity of water, not too small, and to be raised to a certain temperature in the open air; this globe will have a tendency to explode or to collapse, according as the temperature is above or below 100° centigrade. If the atmospheric pressure about the globe be only one half of the ordinary pressure of the atmosphere at the sea level (as, for instance, on the summit of Mont Blanc), the globe will have similar tendencies according as its temperature is above or below 82° centigrade. And so for higher and lower pressures of the atmosphere without, there will be required higher or lower temperatures of the water globe to equilibrate from within the pressure from without. Such a table, expressing the pressure of pure vapour arising from water of given temperature, has been constructed with extreme accuracy by Mr. Regnault; and it results, that by exceedingly rapid methods of exhaustion, water may be made to freeze in the very act of boiling, ice or snow being forms of water which do not in the least interrupt the regular march of the numbers of the table.

Conceive again a sealed globe to enclose perfectly dry air of a given temperature and pressure, and likewise a vessel freely dilatable, including water in sufficient quantity. If the temperature of the globe be high, and the pressure of the air within it be small, the water so included will boil, and the temperature being exactly maintained, the vessel will enlarge until the incumbent air is so compressed in space, as to exert exactly the pressure of the vapour upon the external surface of the vessel. The pressure which now obtains within the globe is that due to the temperature of the water, according to the value assigned in the table before mentioned. M. Lamont assures us, from experiments, that the pressure will maintain this value if the walls of the including vessel be now removed. Dr. Dalton, however, deduced from his experiments a different rule. On removal of the partition supposed to separate the gaseous fluids, more aqueous vapour will be generated in proportion to the space occupied by the air, it will cross the boundary and fill that space *as if it were a vacuum*, the air at the same time will cross the boundary and expand into the space engaged by aqueous vapour *as if it were a vacuum*, and a pressure will result, the sum of that due to the temperature of the water and that of the air originally enclosed.

M. Lamont has found that a globe connected with an iced receiver by a tube one line in diameter may for two hours be occupied by water at a temperature of 100° Fahrenheit without signs of distillation taking place. Yet the pressure within the

globe and receiver M. Lamont found to be compounded of that of the heated air and of the aqueous vapour with which the ærial space of the globe was saturated (by convection). This experiment is proof sufficient, in the opinion of M. Lamont, that the particles of vapour and of air are not, as in the theory of Dalton, indifferent one to another as grains of dust, but exert upon one another a mutual and permanent reaction. Whereas the aqueous particles are incapable, at low temperatures, to exert those pressures by which they might assume among the particles of air positions of equal and independent action, M. Lamont advocates a view that an atomic combination arises between these diverse particles, causing to the saturated air a character of humidity. This character he believes to be imparted to the air by actual contact only with the source of vapour, and not by any transfer of the particles of vapour among the particles of air.

DOUBLE STARS.—OCCULTATIONS.—THE EARTH IN OPPOSITION.

BY THE REV. T. W. WEBB, F.R.A.S.

DOUBLE STARS.

We will return to the constellation *Cygnus*, before it passes away too far to the west, for the sake of a very inconspicuous object, but, at the same time, one of the most remarkable in the heavens—a double star, whose name, 61 *Cygni*, will ever be henceforth associated with a most memorable epoch in sidereal astronomy. The unusual amount of the common proper motion discovered by Piazzi, in this pair, 5″·2 in R.A. and 3″·2 in D. annually, or 1° in 700 years, induced the late eminent observer Bessel to suppose that it might be at a less impracticable distance from the earth than its neighbours, and might indicate that distance by a sensible parallax. He therefore undertook this most delicate and difficult investigation with the great heliometer* at Königsberg, measuring, at different seasons of the year, the interval between the pair and two smaller stars

* The instrument so called, or rather *mis*called, is an achromatic telescope, the object-glass of which, after its completion, is cut across into two halves, each so mounted that the straight edges are capable of sliding against one another, in obedience to a screw movement, the handle of which is brought within reach of the observer. So long as the two halves maintain the same position which they had before bisection, they produce a single image at the focus like an ordinary object-glass; but any lateral displacement has the immediate effect of converting this single image into two, whose distance can be varied at the pleasure of the observer; and in the same way the images of two distant objects in the same field can be made to coincide, and thus micrometrical measurements can be

in the neighbourhood, lying in different directions from it, and whose positions might be assumed as sensibly invariable. Had these measures proved identical at all times, after allowance had been made for the pair's proper motion, the inference would have been that all these four stars were at an equal distance from the earth, or, more correctly speaking, that the difference of their distances was inappreciable by this, or, in fact, any mode of measurement; while, on the contrary, any apparent shifting of place on the part of the brighter pair with respect to its minute neighbours, if it recurred at corresponding seasons of the year, could only be the result of a real motion in the spectator's eye, and would not merely indicate that the stars in question are near enough to change their apparent position when viewed from different points of the earth's orbit, but give the means of estimating their distance from the amount of that change. Sir W. Herschel had already attempted the parallax of the stars by looking out for annual variations in the apparent positions of close pairs; but while failing in one attempted discovery he, as is sometimes the case, stumbled upon another of not less importance connected with the cause of his failure; in trying to find a parallax, the result of one star's being widely removed in point of distance from the other, he detected an orbital motion, the effect of that mutual proximity which rendered parallax inappreciable; and thus his original object was reserved for another generation. Many years afterwards, Henderson, at the Cape of Good Hope, and Bessel, at Königsberg, undertook nearly simultaneously the same important investigation; Henderson attacking α *Centauri*, the most splendid double star in the whole heavens, but lying too far S. to be visible in our latitudes, for the same reason which determined Bessel's choice of 61 *Cygni*, namely, its great amount of proper motion. The priority of observation is undoubtedly due to Henderson in 1832, but to Bessel belonged the earlier announcement, by three weeks only, at the close of 1838, of the discovery of sidereal parallax. It must have been an anxious time for these observers, when they were repeating, night after night, and season after season, the questionings on which depended the first step of our knowledge of the dimensions of the universe; and it must have been an hour of

attained with a high degree of accuracy. These measurements are by no means applicable peculiarly to the Sun, as the very inappropriate name would imply, but are equally available for all objects in the same field. The principle of measurement by double focal images was discovered by Savery, in England, and Bouguer, in France, previously to the middle of the last century; Dollond devised the great improvement of halving the object-glass, and Frauenhofer constructed the first of any celebrity, that mentioned in the text, which has an aperture, I believe, of $6\frac{1}{2}$ inches. There is a still larger one, of $7\frac{2}{10}$ inches, by his successor Merz, at the Radcliffe Observatory, Oxford.

deep gratification when the starry height sent back the first answer ever vouchsafed to mortals—"Our distance is not unmeasurable; our position is not unapproachable; and, as far at least as we are concerned, the language of the book of Job receives a definite meaning for the first time since man was created upon the earth, 'Behold the height of the stars, how high they are!'" The quantities thus brought out were, however, very small, and subject, of course, to causes of error which would in some degree render them uncertain; but by the multiplication and comparison of observations, the limits of such errors can be ascertained, and it may be now stated, with perfect certainty, that the distance of 61 *Cygni* is measurable, and with much confidence that it amounts to about 52,000,000,000,000 miles. Figures thus marshalled speak an almost unintelligible language; and we may possibly aid our bewildered comprehension by stating that this distance is 550,900 times that of the sun from us, and that it would take a ray of light $8\frac{7}{10}$ *years* to traverse it,* while it occupies but $8\frac{1}{4}$ *minutes* in reaching us from the sun, at ninety-five millions of miles. And how strange is the impression following from this truth that we see not those stars, and much less others in their background, *as they are now*. We have not even any proof of their present existence! Had they been, eight years ago, blotted out of the roll of created things, we should still see them glittering in their accustomed place, by the stream of light which had left its source before their extinction; we view them as they were in the year 1853, without the slightest record or intimation of their subsequent history. At the same time, what an idea is given us, by the parallax discovered in this star, of the vast dimensions of that great universe in which we live, and how wonderfully does it, even in this one aspect, declare the Creator's power and Godhead! The sky is crowded with millions upon millions of stars; and of all that countless host, thousands, probably, for one, are at a distance incalculably greater than that of 61 Cygni!—It will require a little close attention to guide us to this remarkable pair, but our readers will probably not consider their trouble ill-bestowed. They must therefore imagine a line from γ *Cygni* to α, and draw a similar one parallel to it from ε (for these stars, see INTELLECTUAL OBSERVER for November, p. 304); this, at a distance equal to that of α from γ, will fall upon a minute object lying a little p, σ 4 mag. and τ, 5 mag.;† two stars near together, which

* These values were somewhat differently given at first; the above are the result of Peters's corrections, applied, according to Bessel's intention, after the latter's death.

† These are the magnitudes given in the larger star maps of the Society for the Diffusion of Useful Knowledge; but it is worthy of remark that at the present time τ *is the brighter of the two.*

will help to identify it; it is much fainter than those stars, but still steadily visible to a good eye. Its data are as follows:

61. 61 *Cygni*. 15″·6. 90°·5. (1830·81). 16″·3. 96°·3 (1839·69). 5½ and 6. Yellow and deeper yellow. Period more than 540 years, according to Bessel, who thinks that their joint mass may be about half the mass of our sun. Their orbit may possibly be 50 times as large as that of the earth. Secchi's measures, 1855·997, —17″·946 and 105°·93,—show its continued motion, contrary to W. Struve's opinion.

Our next object is at the tip of the Swan's E. wing. A line from γ to ϵ *Cygni*, prolonged as far again, but bent rather upwards, catches ζ *Cygni*, 3 mag.; if carried still onwards to the E. and a little to the S., somewhat further from ζ than ζ is from ϵ, it falls upon κ *Pegasi*, a 4 mag. star, a little N. of which is the following, of similar brightness:—

62. μ *Cygni*. 5″·4. 114°·3. 5 and 6. White and pale blue (1839·62, 1850·6). So W. Struve, 1831·63. Sestini made them yellow and more yellow, 1844·5. Dembowski gave "jaune rougeâtre" and "olivâtre," 1853, 1854; "blanc jaune clair" and "jaune cendré," 1855. I found the larger star yellow, 1850·69, 1851·81, while the other showed the curious effect, already mentioned in No. 29 of our list, of an undecided and changeable hue, blue and tawny. At present I see the principal star yellow. A third blue 7½ mag. star, at 3′ 36″·8, completes this beautiful group. Secchi, whose colours are here uncertain and variable, found, for the close pair, 1857·559, 4″·364 and 116°·10, and hence, and from the large value of its common proper motion, he considers that its physical connection is unquestionable.

A little E. of the galaxy, and *nf Altair*, lies a lozenge-shaped group of four moderate-sized stars, the lowermost with a companion close on its right, and another as a pendant to the whole. This is *Delphinus*; more appropriately named than is usually the case with these strangely devised configurations. The *nf*, or uppermost star of the lozenge is—

63. γ *Delphini*. 11″·8. 273°·3. 4 and 7. Golden yellow and flushed grey, 1850·7. Smyth had made the smaller star light emerald in 1839, corresponding more with Struve's *viridicœrulea*. Sir W. Herschel called them both white; whence, as he had a known bias for red tints, Struve infers the possibility of change. This, though without the interest, so far as we know, of physical connection, is a beautiful object, and within the reach of very small telescopes. Smyth commanded it with an aperture of two inches.

In tracing the galaxy from Cassiopea towards the NE. horizon, we soon come to a fine 2 mag. star involved in a lucid glow arising from the presence of a number of minute attendants.

This is *a Persei*, and it forms the starting-point of a remarkable sequence of 4 large stars, at nearly equal and considerable distances, ranging in a great curve towards the right beneath Cassiopea, without the intervention of any remarkable object. Beginning with *a Persei*, the others are γ, β, and *a Andromedæ*, often called respectively *Alamak*, *Mirach*, and *Alpherat*. We must look at the first of these three.

64. γ *Andromedæ*. 11″. 61°·6. $3\frac{1}{2}$ and $5\frac{1}{2}$. Deep yellow and sea-green. This, since its discovery by Christian Mayer in 1778, has been known as one of the most brilliant and beautiful instances of contrasted colour, as well as one of the easiest pairs in the heavens. There is no evidence of orbital revolution, but a fresh degree of interest has been attached to this object since Struve, senior, discovered with the Dorpat achromatic, twenty years ago, that the smaller star was itself an exceedingly close and difficult pair. The distance is given as under 0″·5, and it consequently forms a most severe test of defining power. Cooke's (of York) beautiful object-glasses of little more than 4 inches will elongate it, and Mr. Lockyer, of Wimbledon, has divided it with $6\frac{1}{4}$ inches by the same hand—a great triumph of optical skill. Secchi at Rome actually *measures* it, and calls it *easy!* with the Merz achromatic of $9\frac{1}{2}$ inches, and its division is "a broad dark space" with the new equatorial at Greenwich of $12\frac{3}{4}$ inches, also from Munich. One of the new silvered glass specula manufactured by Léon Foucault (a remarkable invention, of which we shall shortly hear more in England) has accomplished the separation with about the same aperture; but as much has been done by a metallic mirror of $9\frac{1}{4}$ inches, figured by Lassell. I have repeatedly elongated it with my $5\frac{1}{2}$-inch object-glass. The little discs are of unequal magnitude, the nearer to the great star being the larger. A difference of hue was noted by Secchi in 1856, who calls them *subviridis* and *violacea*. The late Sir W. K. Murray, of Ochtertyre, who had a 9-inch telescope by Cooke, discovered independently, in 1857, that they were yellow and blue. Dawes, with an 8-inch Alvan Clark object-glass, made the same observation; and Jacob, at Madras, with the Lerebours achromatic of $6\frac{1}{3}$ inches, though unable to divide them, found the larger end of the *wedge* yellowish, the other bluish. Few of our readers may hope to verify these details; yet it may interest them to know, when they gaze upon that minute speck, what other telescopes exhibit there.

a Andromedæ, already mentioned, stands at the left-hand upper corner of a rectangle of large stars, so fairly regular that the bottom line is sensibly horizontal, and the right side nearly vertical, when on the meridian. This is *the square of Pegasus*, marking the E. portion of that wide-spread constellation. At

the other upper corner is β Pegasi or *Scheat*; the star beneath β is *a, Markab*; γ Pegasi occupies the left corner below. It may assist the student in acquiring the useful practice of estimating degrees, if he knows that the length of the bottom of the square is 17°, and of the right side is 13°, the top being about 16°, and the left side 14°. If from *a Pegasi* we draw a line back to our old acquaintance *Delphinus*, it will pass some way above a solitary star, the brightest in a considerable region. This is—

65. ϵ *Pegasi*. 2′ 18″·1. 324°·3. 2½ and 9. Bright yellow and blue lilac. A 14 mag. star at 1′ 25″ and 327° makes this a triple group with a sufficient aperture. The object is not in itself a remarkable one, but is inserted here as a striking example of a phenomenon which seems to have been first noticed by Sir J. Herschel. He found that when two unequal stars, as of 4 and 9 mag., are situated at a moderate distance (10″ to 60″ or 80″), nearly in a vertical line, on giving the telescope a swinging motion in a horizontal direction, the image of the small star will oscillate, like a ball hung by a string, through an arc greater in proportion to the difference of brightness; sometimes as much as 15° or 20° on each side of the vertical. This he thinks is owing to the longer time which may be required for a feebler light to affect the retina, whence the change of motion in a bright point may be more speedily perceived than in a faint one. ϵ *Pegasi* is an excellent instance of this optical deception: it will, however, be too late to see it well at the present season, as the position of the small star renders it vertical *before* passing the meridian, which it does at about 5h. in the beginning of December; but we shall remember it another year.

A diagonal of the square, from *a Andromedæ* through *a Pegasi*, bent a little downwards, points to a small "caltrop" or triangle of stars, with a fourth in its interior. This inner star is—

66. ζ *Aquarii*. 3″·5. 352°·4 (1838·04). 3″·2. 346°·9 (1852·81). 4 and 4½. Flushed white and creamy. There can be no doubt of the binary character of this beautiful pair, whose connection was discovered by Herschel I. in 1804. Its period may possibly be about 750 years; but an accurate determination is yet wanting. Secchi gives 3″·328 and 344°·03 (1856·835). It is within the reach of small apertures. I have seen it perfectly with 2$\frac{3}{4}$ inches, and less would no doubt have sufficed.

A line from ϵ *Pegasi* through the last object, carried as far again, falls on a group of three small stars close together; the one to the right is—

67. ψ^1 *Aquarii*. 49″·5. 310°·5. 5½ and 9. Topaz yellow and cerulean blue. In fine contrast, but apparently stationary.

Struve, however, asserts a probable connection from common proper motion.

To find our next object we must suppose a line drawn from *Cassiopeia* between β and γ *Andromedæ;* this, at an equal distance beyond those stars, points out three stars lying near together, the two to the right being closest, and the small one being furthest in that direction, as well as lower than its neighbour. These form the head of *Aries,* and the small star is—

68. γ *Arietis.* 8″·8. 359°·8. 4½ and 5. Full white and faint blue. Piazzi Smyth made them both of the same colour, either white or light yellow, on the Peak of Teneriffe in 1856: W. Struve, "egregie albæ" in 1830: Dembowski, both white in 1852, 1854, and 1856. A fine pair, stationary, but, as it seems, moving together through space. Discovered by Hook in 1664 while following the comet of that year; "I took notice," he says, "that it consisted of two small stars very near together; a like instance to which I have not else met with in all the heavens." And in 1837, Struve had catalogued 2787, nearly all much more difficult! A very small telescope will bring it into view. Smyth found two inches of aperture sufficient for it.

Of the three stars already mentioned in the head of *Aries,* the brightest, α, stands to the left. A line from γ *Andromedæ* to this star will leave, a little to the left, and above its centre, two stars, β (4 mag.) and γ (5 mag.) *Trianguli.* Another line from γ, the smaller of these, to α *Arietis,* will pass, at ⅓ of the distance, the following pretty object, which, though visible to the naked eye, must be sought with some care in the telescope, as there are several other not much smaller stars nearit:—

69. ι *Trianguli.* 3″·5. 78°·8. 5½ and 7. Topaz yellow and green. Secchi, who calls this "a most beautiful object," makes its colours white or yellow and blue. It is stationary.

OCCULTATIONS.

Of these, at convenient hours, the month contains only three. December 3rd, 40 *Arietis,* 6 mag., immerges at 4h. 53m. and emerges at 5h. 35m.; 9th, 5 *Cancri,* 6 mag., disappears at 9h. 30m. and reappears at 10h. 37m.; 23rd, τ^2 *Capricorni,* 5 mag., is concealed from 4h. 48m. to 5h. 52m. It may be well to remind our readers that there will be a total eclipse of the moon in the early morning of December 6, though the circumstances are unfavourable, as it begins about 4h. 32m., and the moon sets a little before 8h., just after the middle of the eclipse.

THE EARTH IN OPPOSITION.

It is a curious and a pleasant inquiry, what may be presumed to be the telescopic aspect of our globe from the planet Venus

or Mercury; and though, of course, demonstrative certainty in the reply is not within our reach, we may be led to some interesting conclusions. We shall of course suppose the case of the nearest approach of either of those planets when they pass between ourselves and the sun. In such circumstances, as was explained in No. VIII. of the present work, an apparently retrograde motion will bring us up with a great broad disc into their midnight sky, and all our features will lie open before the distant observer's gaze. There can be little question that the distinction of our continents and oceans would be very perceptible, from the superior reflective power of the former as contrasted with the absorbent property of the latter, which, as is shown by experiments with the diving bell, soon extinguishes the solar rays. The general aspect of the land would no doubt be various from the effect of local colour where sufficiently extensive, and the vegetation of the prairies and pampas would be readily distinguishable from the sands of the Sahara; but diversities on a smaller scale would be merged by distance in a compound gray of the third order of colour: the appearance of the water would also be greatly contrasted in different parts, from its varying degrees of depth and consequent translucency. Islands would, of course, be in general perceptible in proportion to their size as brighter specks; but it may admit of a question whether an island, or, indeed, a line of coast, would be in all cases easily distinguished from an adjacent shallow sea.* The polar regions of ice and snow would of course be strongly marked, with their extension or contraction according to the time of year; but in consequence of the inclination of the earth's axis, their presentation would differ greatly at different seasons: if the supposed opposition of the earth should coincide with our European summer, the N. snows would alone be conspicuous, entering far into the visible hemisphere, but diminishing gradually with the continued action of the sun; if during our winter, the reverse would occur; in spring or autumn each pole would show its white segment at the edge of the disc; but in every case, as our poles of temperature are not coincident with our poles of rotation, and our continental are very different

* "At the eastern extremity of the island, where the rocks break off steeply some hundreds of feet, we saw every object of the port nearly beneath, and apparently within stone's throw. A novel sight to us was the bottom of the harbour, seen through the clear greenish water with considerable distinctness almost from end to end. Patches of sea-weed, dark rocks, and white gravel, seemed to be lying in the bottom of a shallow mirror, across which small fishes, large ones in reality, were wandering at their leisure. This was a picturesque revelation. Upon the surface of the harbour the depth of water very nearly shuts out all view of the bottom. I am beginning to think, that a few thousand feet above the ocean, in a bright day, would enable the eye to pierce it to an extraordinary depth."—Noble's *After Icebergs with a Painter*, pp. 182, 183.

from our insular climates,* the brightness of our arctic and antarctic regions would be unsymmetrical in extent, and their aspect would differ materially as different sides of our globe were brought round by our diurnal rotation. The frozen summits of such extensive ranges as the Himalaya or Andes would no doubt be perceptible with sufficient optical power; but the shadows of our mountains would of course be equally invisible with those in the full moon, and from the same cause; and it does not seem likely that even our largest river courses would have sufficient magnitude to be seen. As the rotation of our globe, combined with the inclination of its axis, would, in successive oppositions, bring the whole of the surface before the eye, it might at first be thought an easy task to map all its outlines with precision; but the atmosphere would in all likelihood interpose most serious difficulties. From its property of transmitting red light, as shown in our sunrise and sunset, and in the face of the totally eclipsed moon, it will probably communicate a slight ruddy tinge to our disc, like a faint wash of red passed over a drawing; but this hue would be very feeble, if at all apparent, in the centre, coming out chiefly from the oblique transit of the ray through the atmosphere towards the edges of the globe; and it would be immaterial compared with the confusion arising from the local condensation of its watery particles. There can be no doubt that Schröter was mistaken in thinking that accumulations of vapour would appear as dark spots upon a planetary disc; the worthy old Hanoverian (and a very worthy fellow he seems to have been) confounded the *interior* effect, or that produced upon an eye beneath them, which, of course, would be one of gloom from intercepted light, with the *exterior* aspect to a distant observer, which would be eminently luminous, few bodies reflecting a more intense white light than the upper surface of a densely compacted cloud: and hence those regions of the earth which are sometimes for months together overshadowed by a cloudy pall, must, to an external eye, present a peculiarly white and luminous appearance; while, for a like reason, the edges of the disc, where oblique vision would render vapour more perceptible, would possess not only the ruddier, as before suggested, but the more vivid light. And thus it is easy to see how baffling an impediment our atmospheric variations must interpose in the way of any accurate comprehension and delineation of the features of our globe, and how the configurations which a distant observer would at one time congratulate himself upon having satisfactorily traced, might, after a short interval, be wholly defaced and obliterated, or so intermingled with the

* See this fact admirably illustrated by Professor C. Piozzi Smyth, in his most interesting and pleasant book, *Three Cities in Russia.*

outlines of superjacent vaporous masses, as to produce a degree of entanglement requiring a long period for the extrication of anything like a reliable result.

Our readers will have easily perceived the bearing of these remarks upon the recent position and aspect of the planet MARS. How far a correspondence between the two globes may be made out, and where the analogy seems to escape us, is an interesting subject of inquiry, as to which, it may be hoped that some of them may have been providing themselves with materials for comparison and reflection.

THE HABITS OF THE AYE-AYE.

BY W. B. TEGETMEIER.

THE opportune arrival of a living mature female Aye-aye at the Zoological Gardens, Regent's Park, has enabled observations to be made regarding its habits and food which tend to modify very considerably the suggestions which were thrown out by Dr. Sandwith and Professor Owen, and which were embodied in a paper published in the first volume of the INTELLECTUAL OBSERVER.

For the greater number of the facts contained in the following short account of the habits of the animal as exhibited in confinement, I must express my obligations to Mr. Bartlett, the superintendent of the gardens, who is ever ready to impart information, and to afford every facility for the furtherance of zoological research.

For an account of the structure of this singular and anomalous animal, I must refer to the paper previously published, Vol. I. p. 130, where its singular combination of the squirrel-like gnawing teeth of a rodent with the grinders and extremities of a quadrumanous animal, are illustrated and described in detail.

In confinement the Aye-aye proves to be a nocturnal animal; during the day it sleeps curled up and covered by its bushy tail. In the night, however dark, Mr. Bartlett states that it moves about in its cage, and gnaws holes in the timber with its powerful rodent incisors. When undisturbed it not unfrequently hangs suspended by the hind claws, and uses the elongated probe-like finger of the hand for the purpose of cleaning and combing the tail, it being passed through the long hairs of that organ with great rapidity; this attenuated finger is also used for the purpose of picking the ears, eyes, and nose, the other fingers being partially closed. The supposed adaptation of this animal's peculiar organization to insectivorous habits,

receives no confirmation from its proceedings as exhibited in confinement, where it has refused every variety of insect food, such as mealworms, grasshoppers, the larvæ of wasps, etc., etc., feeding solely upon thick sweet glutinous fluids, such as honey, or a mixture of milk and eggs; this food is taken by a very rapid movement of the hand, the left only being employed; during the process the fourth finger is thrust into the food, and passed rapidly backwards and forwards between the lips, depositing food at each movement, the tongue and lips being in full motion during the whole time of feeding. Sometimes, though rarely, the animal will lap the food in the manner of a cat.

The conclusion to which Mr. Bartlett inclines is, that the animal is not naturally insectivorous, but that with its large and powerful incisor teeth it excavates cavities in the trunks of such trees as possess a saccharine sap, and feeds upon the fluid that collects in these cavities; this appears the more probable as the Aye-aye is noticed to return repeatedly to the same cavity. It is obvious that we have still much to learn respecting the habits of this singular creature, and its possession must be regarded as a fortunate acquisition to our valuable and unrivalled collection of living animals.

It may be stated as a singular fact worthy of record, that the Aye-aye has not been heard to utter any vocal sound either during the day nor at night, when she seems to exhibit the greatest amount of activity and energy.

COMETS.

AN ACCOUNT OF ALL THE COMETS WHOSE ORBITS HAVE NOT BEEN CALCULATED.

BY G. CHAMBERS.

In the present day it rarely happens that a comet becomes visible without its being observed at any rate sufficiently long for some approximation to the elements of its orbit to be deduced. Such, however, was not the case in days gone by. Observers were few, and of observatories and instruments there were none; and so we are dependent for the information we possess on the writings of the historians and chroniclers, which seldom contain more than bare statements, with few or no details. Instruments and calculations did not come into general use till within the last two hundred years, before which period all accounts are more or less vague and uncertain.

The first who made any systematic attempt to put together the various allusions to comets in the old writers was the French astronomer Pingré, who, in 1783, published his celebrated

Cométographie ; ou Traité Historique et Théoretique des Comètes. This work, which for the industry and labour bestowed upon it, has few equals, has been the astronomer's text-book on the subject of cometary history from the period of its publication down to the present day. No attempt has ever been made to supersede it, the utmost that has been done having been to supplement it by the reproduction in Europe of certain Chinese accounts not accessible in the time of Pingré.

Our present catalogue is of course based upon Pingré's, but in the preparation of it much material assistance has been derived from Mr. Hind's scholarly catalogue, commenced in the *Companion to the Almanac* for 1859, but, unfortunately, since interrupted. Brevity being an essential pre-requisite, we have been obliged to omit much that was interesting, and to confine our attention to necessary facts and figures, only giving a limited number of references.

It may be convenient to make a few remarks on the Chinese observations to which such constant reference is made. They were originally Europeanized by MM. Couplet, Gaubil, and De Mailla, Jesuit priests at Pekin, who made very good use of their opportunities of benefiting science. De Mailla's MSS. were published at Paris in the last century, but the MSS. of Couplet and Gaubil are still unpublished. Within the last twenty years M. E. Biot has done some service by the translation of sundry Chinese catalogues of comets and meteors, and it is not impossible that, as our intercourse with that remarkable people becomes greater, further sources of information may be opened to us.

1770+. St. Augustine has preserved the following extract from Varro :—"There was seen a wonderful prodigy in the heavens, worthy to be compared with the brilliant star Venus, which Plautus and Homer, each in his own language, call the 'Evening Star.' Castor avers that this fine star changed colour, size, figure, and path; that it was never seen before, and has never been seen since. Adrastus of Cyzicus, and Dion the Neapolitan, refer the appearance of this prodigy to the reign of Ogyges."—(*De Civit.* xxi. 8.) This description, such as it is, may be presumed to be that of a comet, but no further particulars have been preserved.

1194+. On the fall of Troy, we are told by Hyginus, a contemporary of Ovid, that Electra, one of the Pleiads, quitted the company of her six sisters, and passed along the heavens towards the Arctic Pole, where she remained visible for a long time in tears and with dishevelled hair, to which the name of "comet" is applied.—(Fréret, *Acad. des Inscript.* x. 357.) What we are to understand by this is doubtful, but it may relate to a comet.

975±. "The Egyptians and the Æthiopians felt the dire effects of this comet, to which Typhon, who reigned then, gave his name. It appeared all on fire, and was twisted in the form of a spiral, and had a hideous aspect; it was not so much a star as a knot of fire."—(Plin. *Hist. Nat.* ii. 23.) *Date* very uncertain.

619 or 618. "We shall see in the west a star, such as is called a comet; it will announce to men war, famine, and the death of several distinguished leaders."—(*Sybill. Orac.* iii.) Though given as a prophecy, Pingré feels justified in citing this passage as a historical record.

612. In August a comet appeared amongst the seven stars of Ursa Major.—(Confucius, *Tchun-tsieou*, quoted by Ma-tuoan-lin.)

533. At the winter solstice, a comet appeared in Aquarius, and the tail of Capricornus.—(Gaubil; Ma-tuoan-lin gives, from Confucius, 531 as the date.)

524. In the winter a comet passed from Scorpio to the Milky Way.—(Gaubil; De Mailla, *Hist. Gén.* ii. 193.)

481. A comet appeared at the end of the year in the eastern part of the heavens. Its length was 2°, and it reached from the star *Yng* (?) to *a* Scorpii.—(Gaubil; Ma-tuoan-lin; De Mailla, ii. 222.)

479. At the time of the battle of Salamis, a comet in the shape of a horn was visible.—(Plin. ii. 23.)

465. + During a period of sixty-five days, an extraordinary object appeared in the sky, according to the testimony of several writers. It may have been a comet, but an Aurora Borealis would seem best to reconcile the various European statements. —(Damachus; Plin. ii. 59.) Ma-tuoan-lin speaks of a comet in 466, which Pingré considers identical with the "extraordinary object" of the European writers.

432. It is certain that a comet appeared in this year.—(Couplet; De Mailla, ii. 244; Ma-tuoan-lin.)

426 or 402. At the time of the winter solstice, during the archonship of Euclides, at Athens, a comet appeared near the North Pole.—(Aristot. *Meteor.* i. 6.) There were two archons of this name, so it is impossible to fix the year of this comet's apparition.

360. A comet was seen in China and Japan in the west.—(Couplet; De Mailla, ii. 267; Kaempfer. *Hist. Japon*, ii.)

345 (?) A comet in the form of a mane, which was afterwards changed into that of a spear.—(Plin. ii. 22.) Date very uncertain. Pliny gives the double date of the Olympiad, and A. U. C., which do not correspond, so one or other must be wrong. Our '345' is from Pingré.

344. "On the departure of the expedition of Timoleon from

Corinth for Sicily, the gods announced his success and future greatness by an extraordinary prodigy. A burning torch appeared in the heavens for an entire night, and went before the fleet to Sicily."—(Diod. Sic. *Hist.* xvi. 11; Plut. *Vit. Timol.*) Pingrê remarks—It is easy to see that the comet appeared in the West, and had a considerable north declination.

304. A comet was seen in China.—(Ma-tuoan-lin; De Mailla, ii. 306.)

302. A comet was seen in China.—(Ma-tuoan-lin; De Mailla, ii. 306.) The Chinese annalist expressly says there were two comets in two years.

295. A comet was seen in China.—(Ma-tuoan-lin.)

239. A comet was seen in China. It came from the East, and passed by the North and in the 5th Moon (June or July), it was seen during sixteen days in the West.—(Ma-tuoan-lin.)

237. In the 9th year of Chi-hoang-ti, a star appeared in the horizon. In May it was seen in the West; it appeared then in the North, and took eighty days to go from Sagittarius to the South.—(Ma-tuoan-lin.)

233. A comet was seen in China in February or March, in the East.—(Ma-tuoan-lin.)

213. A brilliant star was seen in China to come from the West.—(Ma-tuoan-lin; De Mailla, ii. 399.) Probably a comet.

203. A torch extended from East to West for ten days during the latter half of August, or the first half of September. It appeared near Arcturus (*a* Boötis).—(Jul. Obseq. *Prodig. Suppl.*; Ma-tuoan-lin.)

202. A burning torch was seen in the heavens.—(Jul. Obseq.)

171. A large comet with a tail was seen in China at the end of summer.—(Couplet; De Mailla, ii. 554.)

168. A torch was seen in the heavens.—(Jul. Obseq.)

166. A burning torch was seen in the heavens.—(Jul. Obseq.)

165. A torch was seen in the heavens.—(Jul. Obseq.) We are also told that at one place the sun was seen for several hours in the night, so that if this object was a comet it must have been an extremely brilliant one.

156. In October a comet 10° long appeared in the West. It was visible for twenty-one days, and traversed Aquarius, Equuleus, and Pegasus.—(Ma-tuoan-lin; De Mailla ii. 568.)

154 [i.] A comet came from the South-west in January.—(Ma-tuoan-lin; De Mailla ii. 569.)

154 [ii.] In September a comet appeared in the N.E.—(De Mailla ii. 569.)

(*To be continued.*)

PROCEEDINGS OF LEARNED SOCIETIES.

BY W. B. TEGETMEIER.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

DR. MOFFAT read a very interesting paper "On the Luminosity of Phosphorus." If a piece of phosphorus be put under a bell-glass it will be found at times luminous, and at others non-luminous. When it is luminous, a stream of vapour rises from it, which sometimes terminates in an inverted cone of rings similar to those given off during the spontaneous combustion of phosphoretted hydrogen; and at others it forms a beautiful curve, with a descending limb equal in length to the ascending one. The vapour is attracted by a magnet and by heat, but it is repelled by cold. It renders steel needles magnetic, and it is perceived only when the phosphorus is luminous. Daily observations of the phosphorus for a period of eighteen months, show that the periods of luminosity or non-luminosity occur under opposite conditions of the atmosphere; the former being peculiar to the equatorial, while the latter to the polar current. By the catalytic action of phosphorus on atmospheric air, a gaseous body (superoxide of hydrogen) is formed, which is analogous to, or identical with, atmospheric ozone. The author has found that *phosphoric* ozone is developed only when the phosphorus is luminous, and that atmospheric ozone is produced only under these atmospheric conditions in which phosphorus is luminous. From observations extending over several years, it appears that 99 per cent. of luminous periods and 91 per cent. of ozone periods, commence with decreasing readings of the barometer and other conditions of the equatorial current; and that 94 per cent. and 66 per cent. terminate with increasing readings and the conditions of the polar current. Luminous periods commence and luminosity increases in brilliancy on the approach of storms and gales, and ozone periods commence and increase in quantity under similar conditions. There is, it would appear also from these observations, an intimate connection between the approach of storms, the commencement of luminous and ozone periods, and disorders of the nervous, muscular, and vascular systems. The author gave the dates of many storms and gales, and the occurrence of diseases of the above class, showing their coincidence; and in corroboration of what he had stated, he mentioned the fact that there was a concurrence in the issuing of Admiral FitzRoy's cautionary telegrams and these diseases. He also stated that he views the part performed by ozone in the atmosphere as being similar to that performed by protein in the blood; the latter giving oxygen for the disorganization of worn-out tissues in the animal economy—the former giving oxygen to the products of decomposition and putrefaction, and rendering them innocuous or salutary compounds. With these views the

author had used ozone, artificially produced by the action of phosphorus, as a disinfectant in localities tainted with the products of putrefaction.

Dr. Daubeny read a paper "On the last Eruption of Vesuvius:" Vesuvius appears during the last few years to have entered upon a new phase of action. Its eruptions are more frequent but less violent than they were formerly; they proceed from a lower level than they did at an earlier period, and they give gaseous principles, such as the vapour of naphtha and light carburetted hydrogen, never before detected. The last eruption caused an elevation of the coast to the height of three feet seven inches above the level of the sea, which has not been observed on any preceding occasion. Dr. Daubeny suggested that Vesuvius was passing into the condition of a mud volcano, the products issuing from it being simply owing to the action of volcanic heat on the contiguous beds of Apennine limestone containing bituminous matters; hence the carbonic acid and carburetted hydrogen and naphtha vapour emitted, which were to be regarded as mere secondary products, to be distinguished from the muriatic and sulphurous vapours indicating primary volcanic action.

An interesting discussion took place "On Colour as a Test of the Races of Man," by Dr. Crawfurd. The author stated that he considered colour in different races to be a character imprinted upon them from the beginning, because, as far as our experience goes, neither time, climate, nor locality has produced any change. He contended that climate had no influence in determining colour in different races. Finns and Laps, though further north, are darker than the Swedes; and within the Arctic circle we find Esquimaux of the same colour and complexion as the Malays under the Equator. Yellow Hottentots and Bushmen live in the immediate neighbourhood of Black Caffres and negroes. Sir C. Nicholson opposed Mr. Crawfurd's conclusions. The variety of the human races, as they now are, had, doubtless, existed for a long time. Tombs of very great antiquity showed this. But there is now in India a race of Jews perfectly black;* and in China the Jews had long become the same in physiognomy as the Chinese, and the Jews never intermarry. Among the natives of America there was an evident approximation to the Red Indian in physiognomy; they were assuming the hatchet face and losing the beard. The same effect could be discerned among the European population of Australia.

Dr. Gray read a paper on the "Remarkable change of form of the Head which occurs during the growth of certain species of Crocodiles." It is found that when first hatched all the crocodiles have the front of the face shortened and rounded; even those in the adult state have an elongated beak. During growth the nose gradually lengthens and assumes the form characteristic of the particular species; and when the animal attains its adult size, the bones of the head dilate so as to be competent to the support of the large teeth the animal requires in its adult stage. This change of

* The black Jews of India are proselytes, not even claiming to be regarded of Hebrew origin.—Ed. I. O.

form is so considerable that naturalists have regarded the animals when in different stages as distinct species.

ENTOMOLOGICAL SOCIETY.—*Nov.* 3.

Destruction of Injurious Insects by Hard-billed Birds.—In the course of a debate on the destruction of insects injurious to cultivated vegetables, Mr. Mitford stated that, from repeated and careful observation, he had assured himself that the gooseberry and currant caterpillar, the larva of the *Nematus ventricosus*, so well known for its devastating action on the leaves, and consequently on the fruit of the gooseberry, etc., is devoured in great number by sparrows and chaffinches, especially during the period of their feeding their young, and also that this particular caterpillar does not appear to be preyed upon by the soft-billed birds, such as the warblers, etc.

GEOLOGICAL SOCIETY OF LONDON.—*Nov.* 5.

On a Deposit containing Diatomaceæ, Leaves, etc., in the Iron-ore Mines near Ulverston. By Miss E. Hodgson.—The object of this paper was to show that this deposit was deposited in a large cavern or chain of caverns by a subterranean stream, originating probably in a brook called the "Poaka Beck." The authoress first described in detail some of the various caverns and swallow-holes which abound in the limestone of the district, and then alluded to the current belief of their communication with each other, and with springs. Miss Hodgson also remarked that, prior to the year 1842, the Poaka Beck, after having become partially engulphed at Inman Gill, is said to have taken a subterranean course; since the above-named date, its course has been diverted. The paper concluded with a list of the *Diatomaceæ* found in the deposit, with notes on the places where they occur in the streams of the district, and with some remarks on the vegetable remains.

On the Association of Granite with the Tertiary Strata near Kingston. By J. G. Sawkins, Esq., F.G.S.—The occasion of this letter was the discovery by the author of a granitic formation traversing Jamaica in a direction from S.E. to N.W., being the same as that of the earthquake shocks. It pierces the carbonaceous series, and also the Tertiary strata, whence the author concludes that it is of Tertiary age. It usually contains copper-ores, and is often more or less decomposed.

ROYAL GEOGRAPHICAL SOCIETY.—*Nov.* 10.

Explorations in Australia.—Mr. Landsborough's and Captain Norman's expeditions from Moreton Bay to the Gulf of Carpentaria, and thence southwards across the continent to the River Darling, had resulted in the discovery of large tracts of country available

for pastoral purposes. The climate was described as generally healthy; and the valleys of the Baren River and other districts were shown to possess all the elements for the support of a vast population. Sir Richard MacDonnell observed that the theories of vast deserts and inland seas of Australia were gradually disappearing; and he could testify, from personal experience, that although it was neither a rich nor a barren country, yet it possessed excellent materials for the development of pastoral wealth. He also said, that if cotton were to be grown in Australia, he believed the fittest spot for its cultivation would be found near the Victoria River. Sir Charles Nicholson, of New South Wales, agreed as to the adaptability of the soil and climate for the growth of cotton, and stated that 200 bales of cotton shipped at Moreton Bay were daily expected in England. Governor Kennedy, of Western Australia, exhibited two huge oyster-shells, which he was told were worth £140 per ton when imported into this country, a fact rendering that portion of Australia as valuable as the gold-producing ones.

ZOOLOGICAL SOCIETY.—*Nov.* 11.

Discovery of a New British Snake.—Mr. Frank Buckland described the capture, and exhibited living specimens of the *Coronella lævis*, a common European snake, but not hitherto ascertained to be a British species. Several specimens have been captured in Hampshire, etc. This snake is distinguished from the ordinary species, *Coluber natrix*, by the scales not having a raised keel or central elevated line; it is also viviparous, as has been demonstrated by one captured specimen that produced several living young.

CHEMICAL SOCIETY.—*Nov.* 20.

Spontaneously Inflammable Gaseous Compound of Silicon and Hydrogen.—Dr. Hoffmann made a communication to the members on the preparation of this highly-interesting compound, illustrating his remarks by a new and striking experiment. It is believed that silicon belongs to the same group of elements as carbon, but though the normal carburetted hydrogen, $C_2 H_4$, has been long known, indications only of the existence of the corresponding silicon compound have been obtained, and these quite recently. Berzelius pointed out long ago the existence of a body which he believed to contain hydride of silicon—it was a solid, however, not a gas—and will probably turn out to be the hydrated oxide of silicon, since obtained by Wöhler. It is to the latter chemist that we owe the recognition of silicuretted hydrogen. In an experiment where water was being decomposed by a galvanic current, bubbles of a spontaneously inflammable gas were observed to rise from the aluminium electro-negative pole employed. Analysis proved the aluminium to contain a considerable quantity of silicon as an

impurity. The conditions under which the new gas was formed still remained obscure, although Wöhler had done much to clear them up: quite lately, however, Dr. Martius had discovered a way of making silicuretted hydrogen in abundance. A mixture is made of

80 parts of chloride of magnesium.

20 parts of chlorides of potassium and sodium mixed in equivalents.

40 parts of sodium.

70 parts of silicofluoride of potassium.

The various salts, perfectly dry, are first intimately mixed together and then introduced into a wide-mouthed bottle; the sodium, cut into pieces the size of a small pea, is then added, and the whole contents of the bottle well agitated. A tall Hessian crucible having been heated to bright redness, the mixture is suddenly projected into it, and the cover placed upon the crucible. When the mass is fused the crucible is withdrawn from the furnace, broken, and the slag removed. This slag serves, by reason of the silicide of magnesium which it contains, for the preparation of the desired gas. It is necessary to break up the slag into fragments, and act upon them under water with strong hydrochloric acid. The gas, the composition of which seems to be Si_2, H_4, is at once liberated, and may be collected over water or mercury. If a bubble of the gas be allowed to escape into the air, it bursts into flame with explosive violence, a white, hollow, cylindrical ring of smoke ascends, rotating, undulating, and widening as it goes up, and distributing, when it breaks, a multitude of fine flakes of dry silica. All the appearances noticed remind the spectator forcibly of the phosphuretted hydrogen, but there is no offensive smell produced. When the gas is left long in contact with water, the curious hydrated oxide is formed, to which we have already alluded. This substance is white, and when dried and heated in a tube, scintillates just like the analogous substance obtained by the oxidation of graphite. This oxide of silicon has the formula $Si_2 H_2 O_3$.

ROYAL SOCIETY, *November* 20.

On the Fossil Bird from Solenhofen.—Professor Owen read an elaborate paper descriptive of the remarkable fossil bird, from the lithographic stone of Solenhofen, which is described in the article by Mr. Woodward. In the discussion that ensued, the Duke of Argyle and Mr. Gould expressed their belief, founded on the small size and peculiar character of the quill feathers of the wings, that the bird could not have possessed the power of flight. Professor Owen thought that the size of the furcula, or merry-thought, and the development of the ridges on the humerus, which served for the attachment of the pectoral muscles, proved the bird to have been capable of flight.

NOTES AND MEMORANDA.

REMOVING THE HUSK FROM GRAIN.—M. Lemoine adopts a chemical method for this purpose. For example, he places 100 kilogrammes of corn in a tub, and pours over it 15 kilogrammes of sulphuric acid at 66°, and stirs the mixture for fifteen or twenty minutes, then he adds 50 kilogrammes of water, which he decants after a few moments' contact and agitation. The fluid thus removed is reserved for a use he promises to explain. The acid is then neutralized by subcarbonate of soda or potash, and the grain thrown on a cloth with large meshes, and allowed to dry for an hour, after which its dessication is effected on fresh cloths, placed in an airy situation for several days.

COPPER PAINT.—The Abbé Moigno describes in *Cosmos* a new pigment used in the workshops of Mr. Oudry, of Auteuil. Its foundation depends upon the possibility of reducing electrolytic copper to an impalpable powder, which being combined with benzine, can be employed upon any surface as a paint. It possesses an agreeable lustre, and will take bronze tints by the usual chemical means. By reducing the quantity of copper, and adding bases of lead, zinc, or other metals, M. Oudry obtains a series of paints said to possess great advantages over those prepared with turpentine and ordinary oils.

WEBSTER'S OXYGEN PROCESS.—Mr. Pepper describes the new and cheap process for making oxygen in the *Chemical News*. Mr. Webster employs a furnace, containing a strong cast-iron vessel ten inches in diameter, and in this a smaller vessel seven inches in diameter is placed, open at the top, and provided with an orifice at its base, temporarily stopped with a piece of sheet-iron, so that when its contents are exhausted, this pot may be removed, and its contents knocked out with an iron bar. The outer vessel is connected by a pipe with a 30-gallon stone-ware vessel, containing half-a-gallon of water, and eight stone-ware colanders, on which 48 lbs. of the residue of a former experiment are placed, and which acts as a purifier. The inner pot is charged with 10 lbs. warm dry nitrate of soda, and 20 lbs. warm dry crude oxide of zinc, obtained from the so-called "galvanizing baths." A cover is then luted on, and the heat employed only sufficient to give a pasty character to the mass. Oxygen is speedily given off, accompanied by nitrous fumes, which the purifier absorbs. The end of the process is to obtain a large quantity of oxygen at a small cost; but it is mixed with nitrogen to the average extent of 41 per cent. It is expected that this mixture will prove useful to augment the illuminating power of coal-gas, and in various metallurgical processes.

PLATINO-CYANIDE OF MAGNESIUM.—This beautiful salt exhibits the phenomenon of dichroism. In one view it is ruby red, and in another emerald green; crystallized on a slide, it is a magnificent object when viewed with the Lieberkuhn, and dark well, or side silver reflector. With a little pains great variety of effect can be obtained. The crystals that form at the edges of a drop of its solution often make fan-shaped groups of prismatic needles, while the centre is occupied with smaller groups arranged in star patterns, or other ornamental shapes. The angle of the illumination should be changed while the object is under view.

TOOTH OF ORYCTEROPUS CAPENSIS.—Mr. Baker, of Holborn, has furnished us with a little-known microscopic object of great beauty and interest, in the shape of a section of a tooth, which appears to belong to an animal often erroneously confounded with the ant-eaters, from which it differs by being furnished with grinders and flat nails that are strong and curved. It burrows with great facility, and feeds upon ants, which it catches with a long, strap-shaped, protrusile tongue, covered with a viscous fluid. The popular name of this creature is "ground pig;" the scientific appellation we have given above. It is three or four feet long from the snout to the tail, and stands low. Physiologically the teeth are beautiful examples of compound structure, resembling that of the Eagle Ray, figured in Dr. Carpenter's book, *The Microscope*, 3rd edit., p. 704. In man, and usually in the higher vertebrates, the centre of the tooth is excavated into a single cavity containing the pulp, but in the class of teeth to which that of the Orycteropus belongs, the cavities are many, and, as Dr. Carpenter observes, in his *Manual of Physiology*, "we may regard a tooth of this kind as repeating in each of the parts surrounding one of these canals the structure of the human

tooth." Viewed as an opaque object, or when illuminated by the parabolic reflector, the horizontal section of the Orycteropus tooth presents a very elegant appearance, which we recommend to the attention of those engaged in ornamental design. Both in form and colour it suggests patterns for a tesselated pavement, or for fabrics of a fictile or textile kind.

THE ACARI OF SOLUTIONS.—From a paper read by Mr. Shadbolt, and from observations made thereupon at a recent meeting of the Microscopical Society of London, it appears that the Acari which occurred in the electrical experiments of Mr. Cross and Mr. Weekes, and which have since been found in nitrate of silver baths, belong to a species widely diffused. Numbers have been discovered adhering to the walls of a room, and they make their way into any fluids that may be accessible. Thus the mystery of their origin is cleared up, as it might have been long ago, if philosophers had not fancied that their orthodoxy would be compromised by investigating any fact, that for the moment appeared to support the theory of spontaneous generation. It is still puzzling to know how they manage to exist in solutions of a caustic or poisonous kind, which, to all appearance, can contain nothing for them to eat. Mr. Richard Beck exhibited a fine specimen under a binocular microscope, and it closely resembled the *Acarus Crossii* figured in "Noad's Electricity."

ASBESTOS PAPER.—*Cosmos* states that a considerable quantity of paper is made in the Northern States of America, containing one-third of amianthus, or fibrous asbestos, which is obtained at a very low price. This paper burns with flame, but leaves a white residue of the original shape, on which characters that were written with common ink can be read.

IMITATION OF THE HUMAN VOICE.—"On the Boulevard de Magenta, Paris, a remarkable exhibition has been opened. It consists of an instrument which, especially in its upper notes, imitates the human voice so that it might be mistaken for it. This instrument, invented by M. Faber, formerly a Professor of Mathematics in Germany, represents a woman seated, having a larynx constructed of caoutchouc upon physiological principles. It has a range of two octaves, and sings any airs with the tone, pitch, and force of a woman's voice."—*Cosmos.*

75TH ASTEROID.—This body was discovered in September by Dr. Peters, of Hamilton College, New York. It looks like an 11 magnitude star.

CIRCUMPOLAR PLANETS.—M. Radau observes in *Cosmos* that, like Danae, the planet Niobe can become circumpolar in our latitudes, and that it was so, even for Rome, on the 27th October.

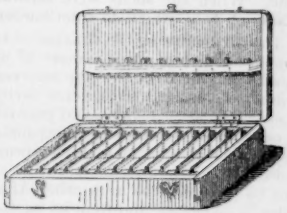
THE METEORIC STONE OF CHASSIGNY.—M. Damour has analyzed the meteoric stone that fell at Chassigny on 3rd October, 1815, and finds it to be essentially composed of silica, magnesia, and protoxide of iron, thus bearing a strong resemblance to the precious stone called *peridot*, and especially to *hyalosiderite*, "which only differs from olivine in a somewhat smaller proportion of protoxide of iron, isomorphous with magnesia." In physical aspect the Chassigny stone is distinguished from other meteorites by its pale yellow tint; it appears composed of roundish grains, with a vitreous lustre, among which are others of a black tint. It scratches glass with difficulty, has a specific gravity of 3·57, contains no nickel nor iron in the metallic state, and it is not magnetic, except in the thin black crust that covers it. This latter circumstance M. Damour attributes to the fusion of the superficial layer having changed the protoxide of iron into $Fe\ O\ Fe_2\ O_3$. He remarks that peridot olivine is found in the meteoric iron brought from Siberia by Pallas, and in that from the desert of Atacama, in the form of vitreous grains. Further details will be found in *Comptes Rendus*, 13th October, 1862.

A BLUE BOLIDE.—M. Eudes-Deslongchamps and his son were in their garden at Caen on the 19th September, when the darkness was suddenly lit up by an intensely blue bolide, the train of which was white. M. D. states that the blue colour was like that produced in fireworks by chloride of copper, and he asks in the paper, read before the French Academy, whether the bolide may not have contained that metal.

ZODIACAL LIGHT.—The French expedition to Mexico will devote attention to this curious appearance, and we notice amongst the papers upon it recently read

before the French Academy, one from M. Heiss, of Munster, who says that his sight enables him to see it nearly all the year, and not only in mornings of March and evenings of September. He reminds M. Faye, to whom his communication is addressed, that he has observed with the naked eye 2000 more stars than Argelander includes in his *Uranometria Nova*.

Arrangement for Carrying Microscopic Objects.—The injury sustained by mounted microscopic objects in being conveyed from place to place, is familiar to all microscopists. The source of this injury arises chiefly from the loose manner in which the glass slides fit into the containing box, and the consequent shaking they receive in their transit from one place to another. To remedy this evil a very successful plan has been devised by Mr. A. H. Church; it is represented in the annexed engraving. Attached to the interior of the lid of the box, in which the slides are to be kept, are a number of small pieces of wood about half an inch long and one-eighth of an inch thick, fixed at regular intervals, corresponding to the spaces between the grooves in which the glasses rest. Inside the lid, and resting on the rounded tops of these little pieces of wood, a piece of silk-covered "elastic" is fastened, from end to end, without stretching. If the parts be properly adjusted, the slides will not shake when the lid is closed, as each slide presses the India-rubber elastic between two of the small studs on the lid, and in this manner is held steadily. The great recommendation of the contrivance is the fact that a single slide is as securely held as when the box is filled. Microscopists will readily appreciate the advantage of an arrangement which enables them to carry any number of objects without producing a continual rattling, and which precludes any liability to displacement or injury from concussion..



Potash from the Animal Kingdom.—The supply of potash has hitherto been solely derived from the vegetable kingdom. Recently, however, M. Maumené, a French chemist, has obtained it in considerable amount from animals. When sheep's wool is submitted to the action of cold soft water, a kind of greasy soap dissolves; this is a combination of certain fatty and oily acids with the alkali potash. It is found that by heating this soap to redness, a very pure carbonate of potash is obtained; this process is so productive that it is worked as a commercial speculation at Rheims, and samples of the various potash salts were shown in the International Exhibition.

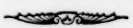
New Applications of Aluminium and its Alloys.—Messrs. Bell Brothers, of Newcastle, have recently produced a new modification which they term "whitened aluminium," in which the unpleasant zinc-like hue of the metal is obviated. They have also formed keys of aluminium, alloyed with two per cent. of nickel to increase its hardness. Aluminium bronze is now made of three qualities, the first containing ten, the second seven and a-half, and the third five per cent. of aluminium, the residue being copper. These varieties of the bronze are scarcely to be distinguished in appearance from gold; their specific gravity, however, being rather less than that of copper (8·95), differs remarkably from that of the precious metal, the specific gravity of which, when pure, is as high as 19·5. From aluminium wire and foil the lighter weights used for chemical purposes, may be advantageously made, since occupying something like seven times the space of those of platinum, they are more easily adjusted and handled, and less likely to be lost. The finest aluminium wire, from its insignificant weight, advantageously serves to suspend from the beam of the balance, objects the specific gravity of which is being ascertained. MM. Collet, of Paris, have constructed a chemical balance in which, not the beam only, but every part, down to the milled head by which the beam is released, is made of aluminium.

The Reaction of Iodine.—At the September meeting of the *Société Helvetiques des Sciences Naturelles*, M. Schönbein pointed out that the proto-chloride

of mercury, and other salts of that metal, had the property of preventing the coloration of starch by iodine, which, however, appeared on addition of chloride of sodium, sulphate of potash, hydrochloric, hydrobromic, or hydriodic acids.

THE FORAMINIFERA OF THE ALPS.—At the same meeting, Professor Kauffmann stated that the foraminifera which were so abundant in the cretaceous rocks of the Alps, resembled those of the same formation in other countries. In order to see them well, it was necessary to polish the stone, heat it to a dark red with a blow-pipe, gently rub the surface with oil, and view with strong magnification. The effect of heating was to bring out the lines of the shells in contrast with the stone. When the shells were separated from the chalk, he mounted them in Balsam of Tolu, which does not harden, in preference to Canada Balsam.

DEVELOPMENT OF TUBULARIA.—At the same gathering, Professor Claparède gave a sketch of the development of hydroida belonging to the genus tubularia. On emerging from the egg the embryos resembled the simplest of the naked-eyed medusæ, although their digestive cavity was a simple sac, which did not give rise to gastric canals. They floated passively on the surface of the water, without the movements of contraction and expansion that characterized true medusæ. From the midst of a crown of tentacles sprung a *manubrium* (literally *handle*), as in the medusæ. This organ exhibited at its extremity a small opening which, by analogy, must be considered as a mouth. After the lapse of some days, the top of the umbrella elongated, and from its surface arose five little eminences surrounding a depression which grew deeper and deeper, and at last constituted a true opening, communicating between the digestive cavity and the external world. This was the true mouth, and the little eminences were the tentacles in an incipient state. At this time the little embryo fixed itself to some body by its manubrium, and gave up its wandering life. The manubrium elongated and constituted, the peduncle of the young tubularia. The primitive tentacles, which at first were directed downwards, as with the medusæ, reversed their position, pointed upwards, and formed the crown of the tubularia.

FORMATION OF RAPHIDES.—Dr. Reinsch, of Bâsle, laid before the same body his observations on the well-known crystalline deposits or raphides in the tissues of vegetables, and especially on those of the root of the *Convallaria multiflora*. He found that when he dissolved, by means of a re-agent, the crystals contained in a cell, there remained a membrane of exactly the same form. This membrane is coloured an intense yellow by iodine, and appears to have the same constitution as the primordial vesicle.

VELOCITY OF NERVE FORCE.—M. Hirsch exhibited to the same Society an apparatus for determining what astronomers call the *personal equation* of time, or the difference which observers make from personal causes in the estimation of minute periods. He said, "We have now introduced the electric method into astronomical observation, and as the observer has only to shut off the current as soon as he sees the bisection of a star, the problem of personal equation consists in determining the time which is necessary for the astronomer to see and execute the necessary movement of his finger. This time, which we call physiological time, consists of three elements: 1. The time occupied in transmitting the impression to the brain. 2. The time taken by the brain to transform the sensation into a volition, and 3, that consumed in transmitting this volition through the nerves, and in the execution of the muscular movement." To ascertain these minute periods, M. Hirsch employs the Chronoscope of M. Hipp. A ball is so arranged that its fall interrupts an electric current, and thus sets free the motion of certain hands. As soon as an observer perceives the fall of the ball, he remakes the contact, and arrests the hands, whose motion in the interval gives the physiological time. By the use of this instrument M. Hirsch has come to the conclusion that nerves transmit their impressions at the rate of thirty-four metres a second. Mr. Heimholz estimated their velocity at 190 feet per second, but his experiments were on the motor nerves of frogs, and those of M. Hirsch on the sensitive nerves of man. We have condensed the four preceding paragraphs and this, from the *Archives des Sciences*, and, with reference to the experiments of M. Hirsch, we should imagine the rate at which nervous impressions travel would probably vary in different individuals, and in the same individual at different times.